DEPARTMENT OF AGRICULTURE AND TECHNICAL INSTRUCTION FOR IRELAND.

REPORT

ON THE

SEA AND INLAND FISHERIES OF IRELAND

FOR

1902 AND 1903.

IN TWO PARTS.

PART I.—GENERAL REPORT.

PART II.—SCIENTIFIC INVESTIGATIONS.

PART II.—SCIENTIFIC INVESTIGATIONS.

Presented to both Houses of Parliament by Command of His Majesty.

AGRICULTURE AND TECHNICAL INSTRUCTION (IRELAND) ACT, 1899.

(62 AND 63 VIC., CAP. 50.)

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To

His Excellency William Humble, Earl of Dudley, Lord Lieutenant-General and General Governor of Ireland.

May it please Your Excellency,

I am directed by the Vice-President to submit to Your Excellency the Report on the Sea and Inland Fisheries of Ireland for the years 1902 and 1903, Part II., Scientific Investigations.

I have the honour to remain,

Your Excellency's faithful Servant,

T. P. GILL,

Secretary.

Department of Agriculture
and Technical Instruction for Ireland,
Upper Merrion-street,
Dublin, 12*th May*, 1905.

Dublin Castle,
13*th May*, 1905.

Sir,

I am directed by the Lords Justices to acknowledge the receipt of your letter of the 12th instant forwarding, for submission to His Excellency the Lord Lieutenant, the Report on the Sea and Inland Fisheries of Ireland for the years 1902 and 1903, Part II., Scientific Investigations.

I am,
Sir,
Your obedient Servant,

J. B. DOUGHERTY.

The Secretary,
Department of Agriculture
and Technical Instruction,
Upper Merrion-street, Dublin.

CONTENTS.

A 2

Inland Fisheries.

Ulster Fisheries and Biology Association.

To The

SECRETARY OF THE DEPARTMENT OF AGRICULTURE AND TECHNICAL INSTRUCTION FOR IRELAND.

Department of Agriculture and Technical
Instruction for Ireland,
Fisheries Branch.

SIR,

I have the honour to submit the following Report, prepared by Mr. E. W. L. Holt, Scientific Adviser to the Fisheries Branch of the Department, and forming Part II. of the Reports on Sea and Inland Fisheries of Ireland, 1902 *and* 1903, *already submitted.*

I have the honour to be,

Sir,

Your obedient Servant,

WM. SPOTSWOOD GREEN,

Chief Inspector of Fisheries.

8*th May*, 1905.

SEA AND INLAND FISHERIES, 1902 AND 1903.

REPORT OF THE SCIENTIFIC ADVISER.

To the Chief Inspector of Fisheries.

Sir,

I have the honour to submit my Report of the scientific work of the Fisheries Branch of the Department for the years 1902 and 1903.

The nature of the researches entrusted to my charge renders it impossible that they should invariably mature in a degree sufficiently complete for inclusion as appendices to a general report presented at a fixed date in every year, but since the results of inquiries are immediately communicated to you for official use it is probable that the delay of their issue in print is not a matter of grave public inconvenience. As you are aware, the duties of myself and my colleagues of the scientific staff involve an amount of travelling which is not conducive to the speedy preparation of perfected reports.

With a view to avoiding delay in the future I propose, with your approval, to publish the results of each particular subject of work in pamphlet form as soon as they become ready, and to issue them at once to the public bodies, societies and individuals for whom they may appear to possess an immediate interest. These several publications will be reprinted later as appendices to my General Report.

SEA FISHERIES.

Trawling.—The survey of trawling grounds, mentioned in my Report for 1901, has been continued with such regularity as the police duties of the Department's cruiser have permitted. It has been possible, when question has arisen of the class and sizes of fish on particular grounds, to extract from our records information which I believe you have found of value in administrative action.

By the courtesy of the Dublin Steam Trawling Company I have been placed in possession of the results of their fishing operations, with information of the place of capture and size of fish. Such information presents a very material addition to the statistics collected by the Department.

In view of the favourable results which have attended deep-sea trawling in other areas, I have taken every available opportunity of directing the trawling operations of the "Helga" to the deep water off the west coast of this country. Apart from the deep-water bake grounds off the south-west, which are already well

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known, I am as yet unable to report the existence of any ground outside the 100 fathom line of particular value, but the area to be explored is vast, and our opportunities of exploring it are, of necessity, greatly limited by other calls on the services of the one vessel which has, practically, to police the whole coast of the country.

International Researches.—In the formulation of the scheme of international fishery investigation by the representatives of various continental powers and of Great Britain it was apparently considered that the waters of Ireland need not be taken into account It is possible that this view may be entirely correct in the interests of the countries concerned. It seemed, however, most unlikely that any results of the investigation could be of material benefit to this country unless we were able, by carrying out similar work at the same periods, to deal with comparable *data*. We have, therefore, so far modified our previous scheme of deep-sea work as to bring our periods of observation into harmony with those of the International Bureau, and to assimilate our methods of observation to theirs in many particulars. Quarterly observations have accordingly been carried out since February, 1903, at a number of stations along the western sea-board, and the results are, in part, dealt with in the Appendix, No. IX., of this Report. Our hydrographical observations are regularly communicated to the international workers, who, in return, supply us with copies of their results, and with any additional information for which we have occasion to ask them.

Our relations with the international council are, however, of an entirely unofficial character.

Irish Lights.—By the courtesy of the Office of Irish Lights we have been able to arrange for the collections at four of their lights of regular observations of water temperature, and of samples of water and floating organisms.

Mackerel Fishery.—The special mackerel work of the Marine Laboratory, consisting of observations made on the Cleggan mackerel grounds throughout the season, has been discontinued, since it appeared that work of this kind had been carried on for a period sufficiently long to give results of as reliable a character as could be expected from it. In this branch of the enquiry the nobby "Monica" was utilised to fish a train of nets, in part of the ordinary commercial mesh and in part of meshes of the different measurements calculated to catch mackerel of any size that might be on the grounds. The position of the nets in relation to the surface was continually varied, with a view to tabulating the presence of fish at different zones of depth, in so far as this may be done by drift nets, which are engines so affected by weather as to prevent the results of one boat's fishing being truly comparable from one day to another. At the same time the physical conditions of the water were observed and collections were made of the organisms which form the food of the fish. Our own catches of mackerel were compared with samples obtained from the local fishery and we were, by the

courtesy of the Congested Districts Board, able to command very exact statistics of the whole fishery of Connaught. Our enquiry is being continued chiefly by means of periodic observations of water conditions and of food organisms, extended over a much wider area and collated, as is now possible, with reasonably accurate statistics of catch over the whole area affected by the Irish mackerel industry. No detailed report of our conclusions can as yet be appended, since in the period during which we have worked it has become evident that the water conditions are so variable in successive years that apparent results based on the experience of a few seasons may be most deceptive.

It is, however, possible to briefly dispose of a question which has attracted some public attention, viz., the alleged injury to the fishery caused by the capture of spawning fish.

In regard to result, it does not appear to matter much whether the parent is caught shortly before, or during the period of reproduction. Indeed, since the latter is in the mackerel prolonged over some considerable time, capture of unspent fish would seem to be more prejudicial to the future stock than capture of fish which will have shed, at least, a part of their ova. Mackerel are already heavy in milt or roe when the fishing commences, the spring fishery being due to the movement or migration contemporaneous with the maturation of the reproductive elements, and it is evident that the protection of the fish, at this season, would abolish the most profitable part of the year's fishery. It may be held that compensation would be forthcoming in the improvement of the harvest fishery; but, though the harvest return fluctuates considerably, not only on the south-west coast, where both fisheries have long been pursued, but also at the west coast stations, established within quite recent years, it cannot be said to have so generally and continuously deteriorated as to afford evidence of having been materially affected by the operations of mankind. According to our experience, gained by examination of the fish taken during several successive seasons, actually spawning fish appear, for the most part, to evade capture, presumably because their reproductive functions are fulfilled at some depth greater than that of a drift net, or, in other words, their surface wanderings in search of food are subordinated to the function of procreation.

Another question, to which our attention is from time to time invited and on which it has always been bestowed without invitation, is the destruction of small mackerel by the spring and summer herring fishery on the south coast. So far as I have been able to discover, the capture of small mackerel in herring nets, in serious quantity, is spasmodic rather than regular. It is, in fact, an accident in a most important industry, and appears to have recurred through a period of years which commenced long before any failure of the mackerel fishery, spring or harvest, could be laid to its account. It may, indeed, be questioned whether the capture of small mackerel would have excited any local attention if the herring boats had belonged to the ports from which they fish.

Herring Fishery.—I have commenced a research which may I hope, throw some light on the general natural history of the herring, and the causes which influence its movements and relative abundance. It is, however, more immediately directed to the establishment or negation of identity in the *personnel* of the shoals which at different times of the year form the object of fisheries. It is commonly asserted that a fishery in, say, the spring is prosecuted at the expense of an autumn or winter fishery, since the later takes only the survivors of the earlier, and so forth. It is possible that we may be able to present reasonably conclusive evidence on this point, which, though but one of many, is perhaps of primary importance. The great difficulty in the way of successful attack on the problem lies in the selective action of the nets used in practical fisheries and in a just interpretation of the same. Our experience in fishing mackerel with a train of nets of different meshes suggests that the selection is much less in practice than it would seem to be in theory, but this is suggestion rather than conclusive proof. It is, however, clear to me that, in open waters, the employment of a single train of mixed nets (the most which I could expect to command) would not yield results proportionate to the expenditure.

Oyster Fisheries.—In my Report for 1901 I referred to the commencement of experiments in oyster culture, and in an appendix dealing with the public oyster fisheries of Counties Wicklow and Wexford, I offered some observations on the Irish oyster industry generally. The re-laying trade, which, owing to the physical conditions of the coast-line, is for the most part restricted to the west, has of late years been greatly hampered by the difficulty of obtaining native seed. Most of the public natural beds from which seed was formerly obtainable have been dredged out. The important sources of supply on the west coast are now restricted to the Tralee and Clarenbridge beds, and although measures have been taken to prevent exhaustion, there is no doubt that both these beds are suffering from a drain altogether disproportionate to their resources.

In consequence, the difficulty which re-layers experience in stocking their beds from local sources is on the increase, and is in fact prohibitive of important enterprise as far as Irish native oysters are concerned.

Our attention has therefore been directed to the devising of a system of artificial production suitable to our climatic conditions, by the adoption of which means might be found to increase the native supply; and, as an alternative of immediate interest, to ascertaining the relative value, for our waters, of the various kinds of English and continental seed on the market.

I offer, in the present report, no detailed account of our experiments in the artificial collection of spat, but a brief notice may be of interest. Work was commenced in 1901, and continued in 1902 in Muckinish Bay, County Clare, an arm of the sea entering Galway Bay near Ballyvaughan. The lower part is narrow, with a considerable declivity, so that the broad area above Finavarra is only reached by the last two-thirds of the

flood-tide from Galway Bay. The channel here divides to surround a large hank, which is very shallow, and in part dry, at low water. In and about this hank was formerly a natural oyster-bed of some local importance, and for many years relaying work had been carried on there, though not apparently on a very large scale during the years immediately precedent to 1901. In the winter of 1900–01 the proprietors commenced to stock the bed to a much greater extent, and in 1901 we obtained from them permission to devote a part of it to our own purposes. On this part we laid down a considerable stock, derived from various sources, and at different points over the whole area we erected crates of tiles for the collection of spat. In 1901 not much was accomplished, owing to delay in the delivery of the tiles; hut in 1902 the experiment was fairly carried out, the crates heing set out in successive months during the summer, so that the date of origin of any spat that was caught could he estimated with approximate accuracy. The quantity of spat caught was not great, and my expectations of the hreeding stock which would be maintained on the heds not heing fulfilled, I thought it advisahle to remove our operations to Ardfry, near Oranmore.

At this place we obtained the use of a natural sea pond, or "saleen," of about sixteen acres, the mouth of which had been fitted with lock gates, so that the pond could be kept full as long as might he desired. The conditions approximate to those of the pools in Norway, of which Herr Wollehaek has given so favourahle an account (see Report for 1901, Appendix, No. VI.). The pond, however, when we took it over in the spring of 1903, required considerable repair, due to damage caused by the February gale, and could not he put in working order in time for us to take advantage of the heat of the early summer of that year. Nevertheless, in our attempt at spat collection in the most unfavourable late summer and autumn which ensued, we obtained some measure of success.

The experience of one year alone is not of much importance, and, if it happens to be the first year of a new system, cannot provide those prosaic details of profit and loss which are of final importance in any undertaking; while the mere capture of spat will not help us much until we can present it, at a reasonable cost, in the form of seed oysters fit for relaying—for which consummation sufficient time has not yet elapsed. I helieve, however, that our work is being so conducted that we shall in the end achieve an answer, positive or negative, to the prohlem of artificial propagation.

The other branch of our enquiry, directed to a comparison of different hrands of imported stock, is also still incomplete, since each successive test has seemed to denote the desirability of further ramifications of research; but, with the assistance of Mr. Hillas, I have prepared a report which deals in a preliminary manner with some of our results (see Appendix, No. VIII.). Perhaps the most striking feature of this report is the light which it throws on the factor of mortality or loss, practically a

single factor, since it matters little to the oyster-grower whether the oyster is alive or dead if it cannot be found when wanted. The observations with which we deal were made on a bed of known excellence, and on which the treatment yielded, in the survivors, excellent results, and are therefore, as I suppose representative of what may generally be expected, rather than illustrative of errors in my own methods of culture and selection of locality. Yet the loss of individuals indicated is very great.

It has been propounded to me, by persons desiring to start an oyster-laying business, that since seed can be bought at about 1*s.* per hundred and sold when fit for market at 8*s.* to 12*s.*, the profits must necessarily proceed on an assured arithmetical basis. But, even apart from temporary conditions of demand and supply, it is quite evident that on our coast at least tho account is complicated by factors other than buying and selling prices, and cost of carc, watching and marketing. On the question of loss I have sought information from practical men on every occasion, and have been compelled to the conclusion that very little of an exact character is known about it. When oysters are kept in pits for the winter pending sale the loss is known, and has risen, according to my information, to near 100 per cent. But in summer, when the stock is below tide-marks, any estimate that can be formed is complicated by the uncertainty of the extent to which the bed may have been cleared before the new stock was laid down.

In France, where oysters are kept in parcs, of which the contents are readily visible, such statements of mortality as I have heard have seemed, if accurate, to indicate natural conditions much more favourable than our own.

At Muckinish it may be taken that the ground on which we made our layings was practically bare of oysters, at least of a kind which could be confused with those which we laid. Our results, therefore, are practically accurate. To some extent our layings suffered from sanding during gales, which were, perhaps, more than usually prevalent during the period of observation, but such chances of fortune are by no means unknown at the mouth of the Thames, the head-quarters *par excellence* of the high-grade oyster industry.

Though loss and mortality are, as I have said, the same in so far as concerns the profits of the relayer, the extent to which an oyster may wander, or, rather, be drifted, is of interest when one considers the cultivation of a large area, or the selection for culture of small plots surrounded by unsuitable ground. Previous to the inception of our experiments Portuguese oysters had never, as far as I could ascertain, been laid on the Muckinish beds. We put down some of this species at a certain place in 1902. In 1903 we purchased from the proprietors of the beds a quantity of oysters for use at Ardfry. Among these were found several Portuguese, and, on enquiry, it appeared quite clear that they had been dredged about a quarter of a mile from the place where they were laid in the previous year.

Apart from loss by mortality or drifting, the apparent loss by temporary sanding is a serious difficulty to the relayer. On several occasions I have had sections of our layings, covered at low water only by a few inches or even dry, cleared for stock-taking purposes. Not an oyster was supposed to have been left, yet on each of two subsequent re-searches considerable numbers were raised, and doubtless some are there yet. Profiting by the advice of a friend who is professionally interested in the industry I have had a supposed empty bed harrowed over, and this treatment yielded a certain number which could not otherwise have been obtained. The expense, however, was out of all proportion to the result, as, indeed, is the expense of re-searching by any means a bed which has once been cleared by ordinary methods of hand-picking, raking, or dredging, according to its depth.

It is, in fact, the immediately available stock that is of importance to the relayer, and not the number of oysters which he may perchance light upon at a future occasion, when he has not an order on hand, and when some of them may be too old for sale.

The loss, whether from mortality or from mere evasion, having proved to be so serious in the case of oysters laid on the ground in the ordinary way, it appeared to me desirable to compare the results of ground-laying with that of keeping oysters in the receptacles known in France as "*caisses ostréophiles*." These are trays with shallow wooden sides and wire-netting bottoms, about six feet long by three feet wide, divided into three compartments, and set up on short legs. In France they are used, as far as I could ascertain, only for protecting the spat removed from the tiles until it is large enough to resist the attacks of crabs, and for this purpose they are covered with similar trays of which the sides are sometimes a little more shallow.

We had tried them at Muckinish for small Aurays of an inch and one-and-a-half inch gauges, and found that in comparison with ground layings they gave incomparably better results.

When visiting the principal seats of the French industry in 1901, I endeavoured to learn why the use of caisses was confined to small oysters, but had to content myself with the general statement that they were not suitable for large stock. It may certainly be that they are not necessary in the system of culture in walled "parcs," where the larger oysters are almost as safe as they would be in the caisses. On our coasts the parc system is but little adopted, and is not everywhere practicable, and while the use of caisses at least prevents disappearance by drifting or sanding, the success of the Norwegian method of culture in baskets suggests that to be actually on the ground is not always necessary for the oyster's well-being. The caisses have the further apparent advantage of enabling the cultivator to utilise muddy tracts in which ordinary layings could not be made.

Our tables suffice to show that oysters as received from the public beds can be carried in caisses to a marketable condition with considerably less loss than is experienced in control ground layings, though it is not yet clear to us that the condition of a ground oyster on a good bed is always equalled by its neighbour

in a caisse. On this point we await the result of further trial, but can say that so far the condition of caisse oysters has compared quite favourably with that of our control layings, and indeed with that of samples of table oysters which we have received from several layings of high reputation.

A most important consideration in the caisse system is the degree to which oysters can be crowded without interference with growth, for on this depends the extra cost of this form of culture. The evidence which we are able to offer is only of a preliminary character.

It is hardly necessary to say that our experience of mortality and loss at Muckinish is not exactly indicative of what may be expected to occur on any other bed on the west coast. In this respect we found a difference as between Ballynakill Harbour and Muckinish Bay and as between different parts of the latter, the mortality, however, being apparently least where the growth was least satisfactory. Nevertheless I consider that the possibility of a loss of stock approximating to that which is shown in our tables is a contingency which intending relayers should take into account before investing in large stocks of material which will require to be held a long time before it is fit for market.

The purchase of large oysters for speedy turn-over is a much more certain business, since if the consignments carry fairly well serious loss does not, according to our experience, begin to manifest itself for some considerable period. In the Appendix will be found tables giving the result of a small experiment in this direction, the operation partaking also partly of the nature of quarantine. Recently a number of English beds have been under suspicion, mostly unfounded, and their products are consequently cheap, but can, I suppose, be completely rehabilitated in the estimation of consumers by a month's sojourn in Atlantic waters, and the difference in buying and selling price seems to leave a fair margin of profit after deducting cost of carriage and care and writing off about 2 per cent. for mortality.

The mention of quarantine leads to the subject of typhoid contagion by means of oysters. The Report of the Local Government Board on this subject shows that the great majority of the Atlantic layings are free from even that measure of suspicion which attaches to the revelation by bacteriological analysis of the presence of certain microbes, which, in themselves harmless, have been supposed to indicate the presence of sewage pollution. It appears by no means improbable that at least one of these organisms has really no necessary connection with sewage, and I am taking steps to have this matter further investigated.

Unfortunately the public do not always consider the difference between these innocent bacilli and the infinitely less hardy microbes of disease, nor do they trouble to read with attention the explanations furnished by bacteriologists of the rational interpretation of their analysis. In consequence, a laying actually acquitted of reasonable possibility of infection may be condemned by the consumer because the report of the bacteriologist

mentions the presence of an organism which is to be found, if only in small numbers, perhaps on every shore suitable for the culture of shell-fish.

The latest pronouncement on the general subject is that of Professor Giard, who reports on behalf of the Council of Sea Fisheries to the French Ministry of Marine. In effect he finds that the alarm is due much more to the inventive faculties of the daily press than to any actual cases of contagion, and that opportunities of contagion present themselves more readily in the establishments of retailers than on the beds from which the oysters are derived.

I think it is certain that one of the reasons for the present depressed condition of trade is that the consumer does not feel sure of the origin of oysters which he is invited to purchase. Much of course depends on the reputation of the retailer, which may not be equally known to all customers, but it seems to me that the difficulty could be obviated to some extent by purchase from the producer, or from the retailer in the sealed boxes of the producer. This, however, is a question of trade, and, though no expert in such matters, I can see that the adoption of the sealed box system would not conduce to bringing high class oysters into the market at a low price, since packages not immediately sold would go to waste.

We are from time to time consulted as to the suitability of particular places for oyster-culture, prior to the application to yourself for a licence. Whenever the topographical conditions have indicated reasonable possibility of pollution I have been authorised to obtain the assistance of a most competent bacteriologist, and by the continuance of this practice I believe that the danger of contagion from new layings in any part of the country may be effectuately averted.

Scientific Papers.

The remaining appendices dealing with marine matters are of a technical description, and may be unjustly suspected of possessing an interest to philosophers only, though in fact they all bear directly or indirectly on fishery problems.

Medusae (Appendix, No. I., pp. 3, 20)—Miss Delap describes the rearing of the large blue jelly-fish, *Cyanea Lamarcki*, a creature well known to and well hated by bathers and fishermen. Besides giving the first adequate account of the life-history of the alternate generations, of which one is a small anemone-like form, while the other is a huge active free-swimming "gall," and so enabling future observers to recognise the animal at all stages of its existence, she also adds most important information as to its role in the marine cosmos. At first a destroyer of the eggs of those fishes which spawn at the season of its early youth, it becomes in later life an active exterminator of other jelly-fishes, and perhaps more than pays for infantile depredations. *Cyanea Lamarcki* appears to regularly invade Galway Bay in the early summer, and, since these notes came

into my hands, Mr. Tattersall and I have seen large members of the species with whole fleets of other medusae enmeshed in their tentacles, while from the stomach of every specimen lifted there fell out a mass of half-digested ctenophores and hydroid medusae. All these creatures, like their captors, fish the sea with retractile tentacles set with deadly barbed poison threads, and if many of them are too feeble to murder even minute fishes, all seem to compete seriously with the latter for the small creatures which form their prey. One species, the medusa of the hydroid *Corymorpha*, appears at times in such abundance that it actually puts a stop to the spring mackerel fishery, choking the nets, and doubtless driving the fish far from the pelagic nettle-bed which it simulates. This is among the forms which have been shown to form a part of the menu of *Cyanea*. It is well known that young fish, after the attainment of the adult form, commonly shelter under the discs of large jelly-fish. At this stage they appear to be immune from the stinging cells of their protector, and perhaps feed to some extent on the genital products which it liberates. I have never met with *Cyanea Lamarcki* in open waters, but in the North Sea I have found young whiting to be the constant guests of the yellow form, *Cyanea capillata*, which there abounds.

Another paper by the Misses Delap deals with the floating organisms observed in Valentia Harbour. For reasons which our present knowledge of Atlantic currents and drifts does not allow us to grasp, this harbour appears to act as an indicator of the set towards our shores of the waters of the ocean, since in it, more than in any coastal area of which I have knowledge, are taken organisms belonging properly to the open sea. Local observations of this nature form a most important corollary of our periodical plankton investigations.

Copepoda (Appendix, No. II., p. 23).—Mr. Farran contributes an important paper on the copepoda taken in some of our deep-sea expeditions. Apart from the interest aroused by the discovery within a comparatively short distance from our coast of a number of species hitherto unknown to science, the work is of specific value in view of the fact that this group of minute crustaceans forms the bulk of the food of the fishes which are the object of our drift-net fisheries, and that evidence derived from the contents of stomachs may, in the light of knowledge of the horizontal distribution of their prey, afford an insight to the recent wanderings of the fish.

Mollusca (Appendix, No. III., p. 53).—Mr. Sykes' memoir on the shell-fish of Ballynakill and Bofin Harbours is a material aid towards an understanding of the exact topographical distribution of these creatures in relation to depths and formations of the sea floor. The general geographical distribution of the inshore mollusca, which form a most important item in the food of many marketable fishes, is fairly well known, but we have much yet to learn of their predilections as to environment and of their habits and movements.

In the second part of his paper the author gives the results of our gatherings of deep-water mollusca up to date, and I trust that we shall be able to avail ourselves of his special knowledge of this group when the area shall have been further explored.

To Mr. Hoyle we are indebted for an account of a squid taken in the surface water over the Porcupine Bank. Our specimen has enabled the author to prove the identity of a number of species previously regarded as distinct.

Mr. Farran notes the re-discovery of *Alderia modesta*, a nudibranchiate mollusc, for which I, and probably many others, have long sought in vain. Of no direct, and, perhaps, of no indirect, economical import this animal yet presents, in the paucity of observations, the difficulty that exists in taking even an approximately accurate census of the inhabitants of our seas.

Schizopoda (Appendix, No. IV., p. 99).—Mr. Tattersall and I present a report on this group of crustaceans, which consists of animals having much the appearance of shrimps or prawns, but furnished throughout life with natatory processes on the limbs of the body.

The somewhat special attention which we have paid to them is due to the known importance of some kinds as food of mackerel and herring, and to the expectation that a reasonably full acquaintance with their movements and habits would throw light upon the same in the fishes which prey upon them.

For the present we deal only with those which inhabit the off-shore waters—of 50 fathoms and upwards, and the material consists of collections made by the "Helga" at various depths between 50 and about 1,000 fathoms, by the s.s. "Oceana" in deeper water off the south-west of Ireland, and by H.M.S. "Research" off the northern part of the Bay of Biscay.

Our results show that a number of truly oceanic forms occur so regularly within a comparatively short distance of our coast that they cannot be disregarded as factors in fishery problems. Among the more sessile kinds it appears that species hitherto only known from the Norwegian coast are equally abundant on our own, while the number of species to which we have had to give names is sufficiently indicative of the paucity of previous exploration of the Irish margin of the Atlantic.

When the reports of the other components of our collections are published it will be found that the schizopoda by no means stand alone in this respect. In an allied group we took, in each of two hauls, more species than were met with in the whole "Challenger" Expedition.

Fishes (Appendix, No. V., p. 156).—Mr. Byrne and I record the occurrence in Dingle Bay of *Dentex vulgaris*, a large southern bream which has not hitherto been met with on our coasts, and offer some observations on the remarkable store of fatty matter which is carried by old males of this and some other Sparoid fishes on the upper part of the head. In another paper we essay to put into a form intelligible to untrained observers the characters which serve to distinguish the different species of soles, and present a brief account of the known habits and dis-

B

tribution of each kind. Common as they are and wide as is the range of literature dealing with them, it is our experience that one sole is very commonly confused with another, with results most prejudicial to the value of records. We propose, in a future report, to deal in the same way with others of the flat-fish kind which offer opportunity for mistakes in determination.

Since our Report on the British and Irish Gobies was issued another species has been added to the list. We have, therefore, brought our notes up to date in this respect.

Echinoderms (Appendix, No. VI., p. 176).—Mr. Kemp contributes a list of the Echinoderms collected in Ballynakill and Bofin Harbours during the operations of the Marine Laboratories at those places, with especial note of their exact topographical distribution. Incidentally he discusses the characters of a *Cucumaria* which has presented great difficulties to the systematist, and, therefore, perforce to the bionomist. In a further paper he records the Echinoderms collected in our deep-sea cruises, and, for the convenience of students of distribution, includes a list of all previous captures of deep-sea forms within our area.

Some miscellaneous zoological notes, which are contained in Appendix, No. VII., p. 207, do not call for special reference here, but Mr. Tattersall's discussion of the larvae of the rather large crustacean *Squilla* illustrates the difficulty experienced in attempting a satisfactory enumeration of the inhabitants of our area. The swimming larvae are taken so constantly on the western fishing grounds that the adult, a burrowing animal, must certainly exist there in some abundance. Yet it has never been taken there, nor, indeed, save in two instances, on any part of the coasts of the United Kingdom.

Another illustration is afforded by the discovery of *Balanoglossus*, a worm-like animal apparently related to the vertebrates, hitherto only known in British and Irish seas in the larval form.

Some public interest has been aroused here by the appearance in the London market of *Nephrops norvegicus*, an animal of the lobster kind, well known to the public as the "Dublin Bay Prawn," and in natural history books as the "Norway Lobster." Discussion in the daily press has enriched knowledge in the usual manner, and we have learned through the same medium that it is the duty of the Department to undertake the culture of the prawns lest they become extinct.

The animal occurs in great abundance on the tracts of muddy sand and mud which form the offshore part of the sea floor off Counties Louth and Down. Its colloquial title is due, I imagine, to the fact of its coming to market in Dublin trawlers rather than to its having been at any time abundant in Dublin Bay, where the soundings are unsuited to its mode of life. The male is much larger than the female, and has relatively enormous claws. It is this difference, I suppose, that accounts for the fact that in a trawl load of "prawns" it is often difficult to find even a single female, the gentler sex being too small to be retained by the meshes of the net. On account of their poor keeping qualities

only the last catches of a trawling voyage are thought worth taking to market, and of these only the largest. In consequence while but few females come aboard all are shovelled over side again, and probably most of them are little the worse of their experience.

It follows that since the female is practically exempt from human interference the danger of extinction is remote and the need for culture not obvious, even if practicable in the case of an animal which appears intolerant of existence in shallow water.

As you are aware, attention has been for some time devoted to the preservation of these animals in tins or bottles, with a view to getting over the difficulties of the fresh market, but this branch of inquiry does not come within the province of my report.

In concluding my remarks on the sea fisheries, I may advert to the successful marketing in London of a true prawn, *Pandalus borealis*, from the deep sea of the Norwegian coast, This enterprise is the direct outcome of a scientific investigation made by Dr. Hjort. The prawn much resembles the prawn of the English market, *Leander serratus*, in general appearance, and is as large as the largest of that species, with which it appears to compete with fair success in the market.

For many years we have been aware of the existence in deep water, off the west coast and in the deeper part of the Irish Sea, of a prawn of about the same size, *Pandalus Bonnieri*, and I have had in mind the possibility of taking it in marketable quantity. Various kinds of gear have been devised for the purpose, but so far we have never succeeded in taking more than a few specimens in any one haul.

Cladophora rupestris (Appendix, No. X., p. 344).—Though sea-weeds are not usually dealt with in fishery reports, a note on this form may be of interest, since, from Mr. Moss' analysis, it appears to possess a possible value as manure, and though very easily collected in the places where it occurs, I do not know that it is ever used as a fertiliser.

INLAND FISHERIES.

Statistics of Salmon Fisheries (Appendix, No. XII., p. 359).—The statistics of private fisheries which have been placed at my disposal for publication indicate a general improvement of a decided character in 1902, this being largely due to the run of peal, though the take of salmon appears to have been, on the whole, not unsatisfactory. In 1903, while salmon seem to have been taken in fair quantity, the take of peal was generally not above the average of recent years, though there was a very good supply of fish which ran too late for the netting season. In such reports for 1904 as have reached me, it would appear that the salmon fishing was generally good, but the peal very few, and in many cases small.

Water conditions have throughout the period covered by this report been generally favourable to spawning and fry, and the runs of smolts appear to have been well up to the average.

Artificial Propagation (Appendix, No. XI., p. 346).—Having dealt at some length with the general question of hatcheries in the last issue of this Report, I have confined my remarks to an enumeration of the output of each hatchery in the seasons of 1902–1903 and 1903–1904, with some discussion of the circumstances influencing natural and artificial propagation. The total output of salmon fry is estimated for the first season at 5,739,000, and for the second season at 4,068,600.

Mr. Charles Green contributes a preliminary note on the variation in size of salmon ova, a matter of importance in estimating the stock in a hatchery.

Mr. Oliver gives a full account of the new hatchery at Lismore, which was built to his designs and specifications, and has proved in every way satisfactory. The plans and schedule will, no doubt, be consulted with interest by every one who contemplates hatching operations, and the information afforded as to the possibility of holding a large stock of spawners in a comparatively small flow of water is perhaps of special importance.

Mr. Charles Green's pamphlet on the construction of hatching apparatus, included as Appendix, No. XIV., in the last issue of this Report, has been in great demand from the Continent as well as from the United Kingdom. Only a few copies now remain in hand, and it is proposed to issue a new edition as soon as time permits.

Experiments have been in progress in trapping salmon for a hatchery proposed to be erected at Newtownbarry, on the Slaney. The trapping of so large a river, having a fairly even gradient, and subject to heavy floods, presents great difficulties, which have not yet been overcome.

A new hatchery is in process of construction on the Deenagh at Killarney, and negotiations in regard to the inception of hatching operations on the Barrow are in forward condition.

By a recent arrangement in regard to funds available for this purpose, the Department are now in a position, in the case of rivers where no preponderating private interest exists to offer to the promoters of hatching enterprise more favourable terms than hitherto. However, while we are prepared to enter into agreements on the basis of any reasonable local contribution, the establishment of State hatcheries is not contemplated; since we may reasonably demand that the public funds shall not be charged with the large and unnecessary expense which would be entailed by the appointment of local managers.

Salmon Marking.—Our marking operations have been continued on as large a scale as possible. The results will be given in continuation of my report on this subject for 1901 as soon as sufficient material has been accumulated. Though the number of fish marked in each year has remained fairly constant, and the marks used have not changed, the percentage of recaptures in

1902 has not been attained in subsequent years. With the utmost reserve it may be suggested that the comparatively high percentage of returns in 1902 furnishes some evidence that the excellent fishing of that season may have been in part due to the survival of an exceptionally large proportion of the fish which were breeding in the previous winter, but our data are insufficient for more than the most tentative suggestion. Marking has been carried on for many years by the Scottish authorities, and has recently been commenced in England by the Board of Agriculture and Fisheries. I am in communication with the Fisheries Staff of the two Kingdoms, and may mention as illustrative of the necessity of co-operation in such matters, that a label attached to a fish in an Irish river, and taken from it a few miles up the same river, only reached me after it had passed through the hands of the Inspector of Salmon Fisheries for Scotland!

Mr. Singleton has informed us that he has marked fish on the Bundrowse with silver labels distinguished by the letter S. I have not heard that any fish so marked were recaptured, and am not aware of any other instances of marking in Ireland except with labels supplied by the Department. The capture of a fish supposed to have been branded was reported to us from the River Barrow, but the marks were illegible, and I did not succeed in ascertaining by whom they were placed on the fish.

Pollen Fishery.—In your report for 1902 you referred to the results of an experiment carried out under my direction for the preservation of linen pollen nets from the attacks of "water crickets," *Asellus aquaticus*, a species of Isopodous crustacean generally distributed in Irish lakes. It being known that creosote was repugnant to an allied marine Isopod, a test of the creosote preparation used for curing sea nets naturally suggested itself, and the result showed that, without lessening the fishing efficacy of the pollen net at all, this substance completely protected it from the attentions of the "water cricket." Leaflets explanatory of the process were immediately issued, giving information as to where the creosote could be procured.

Difficulty subsequently arose in the provision of the stuff during the season for which it was required, supply being regulated by considerations of sea fisheries only.

We accordingly asked Messrs. Harrington Brothers, the well known manufacturing chemists of Cork, to supply us with a cheap form of creosote for experiment. This was done, and the result proved quite satisfactory. The price quoted to us was 3*d.* per lb. in 1 cwt. lots (package, 2*s.* 6*d.* per cwt.), delivered Dublin. It could also be supplied in gallon tins, at some extra cost, in 1 cwt. lots.

It is to be noted that when the nets are boiled in "soda ashes," as is the custom at Lough Neagh, the creosote should be applied after and not before this process. Since the treatment appears in no way to interfere with the fishing of the net, it is probable that creosote may be found useful in the preservation of all kinds of fresh water nets.

I must express our thanks to Messrs. Barbour & Sons, of Lisburn, for their kindness in supplying free of charge the nets used for experiment, and for reporting on the result of fishing the nets.

Reports of Clerks of Conservators (Appendix, No. XIII., p. 363). In pursuit of the arrangement mentioned in my last Report, so much of these returns as appears to be of scientific rather than of administrative interest is now extracted for publication here. In future issues the practice of comparing in parallel columns the returns of two years will be continued. I have already referred briefly to the subject matters of the returns.

Ulster Fisheries and Biology Association.

Having learned that the formation of a marine Biological Association was in contemplation at Belfast, I was authorised by the Department to offer the promoters of this enterprise some financial support, in the early stages of its existence, in consideration of its energies being in part directed to investigations in which the Fisheries Branch has an interest. It may be that the desire to encourage the first of such societies to be formed in this country was more present in our minds than any immediate expectation of valuable assistance. The Society was duly formed under the title which I have quoted above, and chose for its head-quarters Larne Harbour, choice being of necessity limited to places of easy access from Belfast, where most of the members of the association reside or have business. A house was fitted up as a laboratory, and a small steam launch was purchased. Professor Wilson, of Queen's College, Belfast, was appointed Honorary Director, and Mr. Pearson, B.Sc., a biologist from Professor Herdman's laboratory, was engaged as resident naturalist.

The Department provided apparatus to the value of about £28, and for the first year's work promised a subsidy of £150 on condition of the association devoting a portion of its attention to certain subjects and furnishing reports of the results. Subject to general directions from myself, the association was free to conduct the researches as seemed best to it. In the selection of the marine portion of the programme I may own that I was guided by the difficulty of conducting fishery research from a centre such as Larne, and with equipment limited to a small steam launch, especially in the case of a society chiefly dependent on the exertions of members who had enjoyed no previous training in marine biology. The chief subject selected was therefore a study of the fauna of Larne Lough in relation to the depths and nature of bottom deposits, and the seasonal movements of such marketable fish as enter the lough.

Since Belfast is within easy reach of Lough Neagh, the association was asked to undertake a study of the schizopod *Mysis relicta*, which forms the principal food of the pollen. Except for a doubtful record from Lough Erne, to which it may possibly have migrated by means of the canal, *Mysis relicta*

is known elsewhere only from the great lakes of Continental Europe and of North America. In suggesting the acquisition of a proper knowledge of its natural history, I had in view the possibility of acclimatising an organism so valuable as a fish-food in other large lakes in this country.

At the end of the first year's work reports were duly furnished by the association, but the researches were not in so forward a condition as to be available for publication here.

The first year's subsidy having been fixed at £150 for special reasons, that of the succeeding year was reduced to £100. The association was asked to continue its observations on *Mysis relicta*, but in regard to marine work I thought it advisable to invite assistance only in the examination of herring in connection with the research which I have referred to in a previous portion of this report. Thus, while in receipt of a substantial subsidy the association is unfettered as to the pursuit of purely biological study.

In conclusion I desire to acknowledge the assistance which I have received in the work of scientific investigation from my colleagues, the Assistant Naturalists, and from the Technical Assistant of the Fisheries Branch. To Mr. C. Green I am especially indebted for help in the preparation of this Report.

I have the honour to be,

Sir,

Your obedient servant,

E. W. L. HOLT,

Scientific Adviser.

APPENDIX

TO THE

REPORT

ON THE

SEA AND INLAND FISHERIES OF IRELAND

FOR

1902 AND 1903.

PART II.—SCIENTIFIC INVESTIGATIONS.

INLAND FISHERIES.

Appendix, No. I.

i.—Notes on the Plankton of Valencia Harbour, 1899-1901, by M. and C. Delap.

ii.—Notes on the rearing, in an Aquarium, of *Cyanea Lamarcki*, Peron et Lesueur, by M. J. Delap.

i.—NOTES ON THE PLANKTON OF VALENCIA HARBOUR, 1899-1901,

BY

M. & C. Delap.

The following notes continue the record of townettings taken in Valencia Harbour during the years 1895—1898, and published in the Proceedings of the Royal Irish Academy, Ser. III., Vol. 5., by Mr. E. T. Browne.

Having succeeded in rearing *Chrysaora isosceles* to maturity (*Irish Naturalist*, February, 1901), we were encouraged to try *Cyanea*, and the result is given in the accompanying paper.

We are greatly indebted to Mr. Browne for his kind help in revising and correcting our notes, and identifying specimens.

These notes give the results of townetting and collecting for the years 1899—1901.

The hauls are generally taken near Reenagiveen Point, or about a quarter mile further down the harbour, towards the lighthouse, on a flood tide.

When the surface of the water is calm, the jelly-fish are lifted in a jar by hand, and in this way more perfect specimens can be obtained than by the townet.

The temperatures are taken on the surface from the boat when townetting, or from the rocks at Reenagiveen (when too rough for boating), where the water is deep, and a strong tide flows past.

During the winter months, December, January, and February, marine organisms are very scarce, a few copepods only being taken. This is probably due to heavy seas and stormy weather.

Young stages of medusae, fish eggs, &c., make their appearance towards the end of February, and copepods become plentiful from the beginning of April. From May on throughout the summer months, jelly-fish, &c., are generally abundant, and again after the autumn gales a drift of ocean forms sometimes appears, such as the crowds of Cupulita, Solmaris, Salps, &c., in November, 1901.

The tables (pp. 16 to 19) give the monthly distribution of the various medusae, and other organisms noticed or taken in the townet.

Protozoa.

Noctiluca miliaris.

1899.—It was first seen on August 25th; very abundant until October 6th.

1900.—In September and October; especially abundant on September 23rd.

RADIOLARIA.

1899.—Shoals appeared in August and September.

1900.—Shoals in July, August, September, and October.

1901.—In August, September, and October.

SIPHONOPHORA.

Velella spirans (Forskal).

1899.—In April a shoal of very small Velella were seen; some measured only $\frac{1}{8}$-inch in length.

1900.—A large shoal in June.

1901.—One large specimen in July.

Muggiœa atlantica (Cunningham).

1899.—None seen.

1900.—They were fairly plentiful in the harbour from June to October; abundant in September.

1901.—A few in October and November.

Galeolaria sp.?

1899.—A number of these large Diphyes appeared in May; the swimming bells of some of the specimens measured an inch in length; the stem when extended was a foot long, and very bright scarlet at the end.
It swims very rapidly, jerking the foremost bell quite out of the water.

1900.—In April three specimens were taken and about a dozen others seen. In July, eight specimens on the 14th, three on the 16th, and several on the 29th; others seen.

1901.—On April 26th two large ones were captured, and others seen. A few were seen in May, one in June, and two on November 5th.

Cupulita Sarsi, Haeckel.

1899.—Some were taken in January; fairly common from May until November. The largest specimens taken were some in September, which measured nine inches in length, and with twelve pair of nectocalyces.

1900.—The first specimens were taken on April 22nd; plentiful from then until the middle of October; most numerous in September.

1901.—Fairly common from April to end of November.
On November 5th, 6th, and 7th there were such shoals of them in the harbour that it would have been impossible to use a townet. The largest in this shoal had about twenty pair of nectocalyces, and a very long red stem.

Agalma sp.?

1899.—A specimen of Agalma was taken on July 21st with tricornuate tentilla. It was in a shoal of cupulita.

Anthozoa.

Arachnactis Bournei, Fowler.

1900.—In March and April these were fairly common in the townet. Some of them were kept in an aquarium; they settled down in the gravel on the bottom. One of these still survives (1903). It measures about an inch across the tentacles, which are about twenty in number; it is very sensitive, and draws itself down into its hole if disturbed. It is very like the anemone "Cerianthus."

1901.—None seen.

Halcampa.

The larval form is often taken attached to Phialidium. Several were kept alive, and they attached themselves to stones in the aquarium, and lived there for more than two years.

Ctenophora.

Pleurobrachia pileus, Modeer.

1899.—Common from April to November. In April and in August in such shoals that it was impossible to use the townet.

1900.—Plentiful from March until the end of October.

1901.—From March to the end of November; great shoals in June.

Bolina norvegica (Sars).

1899.—Taken in the harbour from March to November; very abundant in May and August.

1900.—In April a few large ones appeared; some measured three inches in length. Very many in June and July; one was measured on July 16th, five inches long. They continued in the harbour until the end of September.

1901.—Common from March to November. The largest shoals appeared the first week of November; these were very large specimens. A heavy gale on the 11th broke them up, and only a few were seen after that date.

Beroe ovata, Eschscholtz.

1899.—A few Beroe appeared in June; common in August and September.

1900.—In June a few were taken; more numerous in July. Some very large ones were taken on July 14th and 16th. Common until the end of September; on September 5th some very pink specimens measured six inches in length.

1901.—One on February 21st; fairly common from May to November.

Echinodermata.

Bipinnaria.

1899.—One specimen was taken on July 29th and another on August 1st.

1900.—Several seen in April and one in September.

1901.—On November 5th, 6th, and 7th great numbers were seen. These were large specimens, with the little red starfishes well developed. Pluteus nearly always in the tow net during the summer.

VERMES.

Tomopteris onisciformis, Eschscholtz.

1899.—One specimen was taken in the townet on January 28th; a few during May, June, and July; common in August and September.

1900.—A few in March and April; common from June to October.

1901.—Taken in every month from May to November. On November 29th the townet was choked with Tomopteris and Sagitta.

Sagitta bipunctata, Quoy et Gaimard.

1899.—Taken in January, and in every month from April to September, both included.

1900.—A few were taken in March, fairly common in April; and in June, July, August, and October.

1901.—Taken in February, March, April, and May; and again in September, October, and November. Very abundant on November 29th.

CRUSTACEA.

Phyllosoma.

1899.—One specimen captured on May 8th.

MOLLUSCA.

Ianthina communis, Lamarck.

1900.—On June 24th five small Ianthina were found stranded on the rocks, and another on 26th. A number of Velella appeared in the harbour on same dates.

Four more Ianthina were found on July 5th and 6th; three large ones on August 4th. Some large ones were picked up on the strand at Rossbeigh, about twenty miles distant, and were probably part of the same shoal.

PTEROPODA.

Limacina retroversa (Fleming).

1899.—None seen.

1900.—Plentiful all through June. On 15th the townet was completely choked with them.

1901.—None were seen.

Clione limacina (Phipps).

1900.—Fairly common from June to October; very abundant on June 15th.

1901.—Taken in June and in November.

PHORONIDEA.

Actinotrocha sp.?

1901.—One specimen was taken on October 30th.

TUNICATA.

Thalia democratica—mucronata (Forskal).

1899.—A few specimens on May 8th and 9th; solitary specimens with brown "nucleus."
One taken on June 2nd.

Salpa runcinata—fusiformis (Chamisso-Cuvier).

1901.—On November 5th nine specimens were taken; others were seen, but swimming too deep to catch. A few taken on the 6th and 7th; then a large shoal appeared, both chains and solitary individuals. Some measured $3\frac{1}{2}$ inches in length. The "nucleus" is reddish orange in colour, but looks white when seen at a great depth. The chains move very quickly, and are hard to catch, as they sink when touched. The longest chain captured numbered sixteen salps. Single specimens were easily preserved in formaline, but though various methods were tried, it was found impossible to preserve the chains intact. The shoal remained about the harbour until November 15th, when the weather became stormy, and they disappeared.

Doliolum sp.?

1901.—One specimen taken November 29th.

Oikopleura.

1899.—Generally common in the spring and early summer.
Very common in May and June.

1900.—Taken in April and in June.

1901.—Common in April and May.
On May 10th the tow net was quite choked with them.
Taken also in August, September, and October.

PISCES.

Fierasfer sp.?

1901.—On November 6th a specimen was taken, measuring 70 mm. in length.

. . . .

Sometimes large shoals of certain animals appear in the harbour, and townetting is useless, as the net gets soon choked with them. This was the case on following dates:—

1899.—On May 16th and 17th, *Pleurobrachia* and *Bolina*.
On August 21st, *Pleurobrachia*, *Bolina*, and *Cupulita*.

1900.—May 10th, *Corymorpha* and *Oikopleura*.
May 30th, *Corymorpha*.
June 15th, *Limacina retroversa*.
June 20th, *Bolina* and *Pleurobrachia*.

1901.—On November 7th, such numbers of *Solmaris* that the water looked quite grey with them; *Cupulita* almost as numerous.
November 29th, *Sagitta* and *Tomopteris*.

Anthomedusae.

Amphinema dinema (Péron et Lesueur).

1899.—A few specimens in May, June, and July; more plentiful in August and the first part of September.

1900.—Scarce in June; only one in July; a few in August and September.

1901.—A very young specimen taken on March 16th; one in May; one in August, and several in November.

Cladonema radiatum, Dujardin.

This medusa has not been taken in the tow net. The hydroid is common in our bell-jars, and the medusa is very easily reared to the adult stage.

Clavatella prolifera, Hincks.

A specimen occasionally appears in the bell-jars, but the hydroid has not yet been seen.

Corymorpha nutans, Sars.

1899.—This medusa appeared in the middle of April; very abundant during May and June; a few in July, August, and September.

1900.—A specimen was taken on April 6th, and another on the 14th.
In May it appeared in the bay outside Valencia Harbour, in such a vast shoal that the drift-net fishing was considerably interfered with. Very abundant inside the harbour during May; a few seen in June and in August.

1901.—Some specimens were taken on April 16th. In May there was an enormous shoal of *Corymorpha*, both inside and outside the harbour. The mackerel fishermen reported to us that the "dirt" was very bad, and that their nets were thickly coated with medusae.
The weather was then hot and the sea calm. *Corymorpha* was also abundant in June.
A solitary specimen was captured in October.

Cytæandra areolata (Alder).

1899.—On May 15th five specimens were taken, one with thirty-one tentacles. Two more were taken on May 20th, and two on August 10th.

1900.—None seen.

1901.—A large one captured on March 22nd with twenty tentacles, one on May 3rd with thirty-three tentacles, and a few in the last week of the month.

Dipurena ophiogaster, Haeckel.

1899.—One specimen taken on May 20th, several in June, a few in July and in September.

1900.—Several were taken in May and in June, many in July, and a few in August.

1901.—One specimen on May 13th.

Dipurena halterata (Forbes).

1899.—Several were taken in June, a good many in July. Most of them were fine adult specimens.

1900.—A few very small specimens in July, another small one in August, two in September, and one in October; all young stages.

1901.—One on November 15th.

Ectopleura Dumortieri (Van Beneden).

1899.—Taken in every month from April to August, but never plentiful.

1900.—Taken from May 31st until October 15th; most frequently in July.

1901.—Very scarce from April to September. One abnormal specimen was noticed with eight canals and tentacles, and sixteen bands of nematocysts on the ex-umbella.

Euphysa aurata, Forbes.

1899.—Very young stages in April; more frequently in May. Very scarce in June, July, and August.

1900.—Only one seen in April; a good many in May and June; very few in July and August.

1901.—A few taken from April to July.

Hybocodon prolifer, Agassiz.

1899.—This medusa only occurs in the spring. One taken on March 31st with medusa-buds.
Several on May 15th with buds.

1900.—Some taken on April 6th, and more in May. Several in May had well developed actinulae attached to the stomach, as well as medusa-buds on the tentacle bulbs.

1901.—A few seen in April; fairly common during May.

Lar sabellarum, Gosse.

1899.—A very young stage was taken on March 1st. During March and April early stages—especially the first stage—were present. Scarce in May and June; fairly plentiful in July, August, and September.

1900.—None seen until the middle of June; very scarce through July and early part of August. On August 25th a considerable number were seen; then very scarce until the end of October.

1901.—One taken on February 20th, one in March, a few in April; then a few taken each month until the end of November.

Lizzia blondina, Forbes.

1901.—One adult specimen on February 14th.

Margelis.

Specimens of Margelis were frequently taken in 1899, 1900, and 1901, but the species were not identified.

Margelium octopunctatum (Sars).

1899.—Two specimens in February; few in April and May; all with medusa-buds. Scarce in June, August, and September.

1900.—Two were captured on March 5th; a good many seen and taken in the townet during March and April. More numerous in May, June, and July; very scarce in August and September.

1901.—On February 14th two were taken; some in April with ova; two in June; a few in September, and three in October.

Sarsia gemmifera, Forbes.

1900.—On July 20th a specimen was captured with several medusa-buds on the manubrium.
Amongst several taken on July 25th was one with thirteen medusa-buds. A few more were seen until the end of the month.

1901.—None were seen.

Sarsia eximia (Allman).

1899.—Several were taken on June 20th and 22nd.

1900.—On May 14th one specimen was seen.

Sarsia prolifera, Forbes.

1899.—A few on May 3rd; common during the last two weeks of June. A few in July and August.

1900.—Common in June and July; those in July had medusa-buds and ova.
Very abundant in August.

1901.—None were seen.

Sarsia tubulosa (Sars).

1899.—Very common in the harbour in May and June; scarcer in July; none seen after August 1st.

1900.—Common in the harbour in May, June, and July.

1901.—A few during April and May; abundant in June; scarce in July; very few in September and October.

Tiara pileata (Forskal).

1899.—One very young specimen in March; a few in April; abundant in May.
Some very large, brilliantly coloured ones on May 9th, measured 40 mm. in length. Young stages appeared towards the end of the month, and in June and July. Common in August and first half of September.

1900.—Abundant in May; some of these very large specimens. A few small ones seen in each month until the middle of October.

1901.—A few taken in April; very abundant in May, especially towards the end of the month. A good many seen in June; few in July, August, and September; common the first two weeks of November.

Gemmaria implexa (Alder).

1900.—One taken on June 3rd with four tentacles, and one on July 21st with two tentacles and two bulbs.

1901.—On September 24th one specimen with two tentacles.
On September 25th three were taken, each with two tentacles.

LEPTOMEDUSAE.

Agastra caliculata (Hincks).

1899.—One on August 1st in the tow-net.

1900.—One on June 29th and another on July 20th.

Dipleurosoma typicum, Boeck.

1899.—This medusa is common in the harbour from May to September. A few were taken early in May; very abundant towards the end of the month, and very common until the middle of September. No very young stages were seen; nearly all were mature specimens. In July an attempt was made to rear the planulae of *Dipleurosoma*. They developed into very minute hydroids. These were kept alive for some time, but did not develop any further.

1900.—One specimen on May 24th.
Very common in June and July; few in August and September.

1901.—Common from May 20th; very plentiful in June and July; none seen in August, and only a few in September.
Hydroids were again obtained from planulae, but with same result as before.

Euchilota pilosella (Forbes).

1899.—One damaged specimen on April 26th; a few in May and June; none in July; a good many seen in August.

1900.—A number of large specimens seen on May 28th. Common all through June. Some taken on June 13th measured 48 mm. in diameter. Some of these large ones deposited ova, which in two days developed into planulae, and on the third day settled down and developed into minute hydroids. It is rather like that of *Dipleurosoma*. The hydroids remained alive for some months, but did not grow or develop further. A few more specimens were taken in July, August, and the early part of September.

1901.—Very common all through May and June.

Eutima insignis (Keferstein).

1900.—One small specimen on June 20th with only three tentacles. Several large ones on July 28th, and one on August 25th.

Laodice calcarata, Agassiz.

1899.—*Laodice* was very common from May 1st, some very large specimens being taken. A few early in June, and some young stages in July; two of these had only four tentacles. Very abundant in August; large pink specimens, and a few early in September.

1900.—Some appeared in June; very few in the first part of July; more towards the end of the month; common in August and until the beginning of September.

1901.—A very small one on April 23rd; abundant in May; one in August; few in September; two in November.

Melicertidium octocostatum (Sars).

1901.—One fine specimen on May 26th.

Obelia nigra, Browne.

1899.—This is quite the commonest medusa in the harbour. It is almost always to be found from March until November; sometimes in such quantities that it is useless to tow-net.

1900.—Common from March to October.

1901.—From April to November.

Octorchis Gegenbauri, Haeckel.

1899.—Three specimens were taken in September.

1900.—Three in July and one in August.

1901.—None were seen.

Phialidium cymbaloideum (Van Beneden).

1899.—A few very small specimens taken in March and April. A number in May; many of them with *Halcampa* attached to them. Common in June and July. On July 17th the tow-net was full of very small ones. Abundant in August and until the middle of September.

1900.—Some very young stages in April. Fairly common in May; abundant in June and July; common in August, and scarce up to the end of October.

1901.—Very few in April; abundant the last week of May; common June and July; scarce every month until the first week of November.

Phialidium temporarium, Browne.

1899.—Young stages in January, February, and March; very abundant in May and June; a shoal of very large specimens on June 9th; common July, August, and September.

1900.—A few very young stages in March and April; common until the middle of September.

1901.—Taken in every month from early in February until November; unusually numerous in May, when shoals of very large specimens made townetting impossible. They were taken until November 29th.

Phialidium buskianum (Gosse).

1899.—This species is scarce, compared to the other two species.
Two specimens in July; a few on August 25th and September 2nd; a number on September 9th.

1900.—None were seen.

1901.—A few specimens on September 16th.

Polycanna forskalea (Péron).

1899.—A small one on May 10th measured 11 mm. in diameter; two small ones in August measured 13 mm. and 38 mm. respectively.
Two specimens on August 14th and one on August 25th only 6 mm. in diameter. These specimens were all colourless.

1900.—One pink specimen on June 26th measured 45 mm. in diameter. It had 67 canals, 58 bulbs and tentacles, and one or two vesicles between every two bulbs.
Two small ones on June 4th were quite colourless; one measured 17 mm. in diameter, 34 canals, 50 tentacles and bulbs; the other 25 mm. in diameter, 50 canals, and 94 tentacles and bulbs.
On September 1st twelve specimens were taken, all pink; some more on the 10th, and a large one on September 21st, also pink, measured 175 mm. in diameter, 63 canals (all to the margin), 84 tentacles and many bulbs, 8 to 12 vesicles between the tentacles.

1901.—A small pink specimen on May 22nd with 80 canals and 22 tentacles. On November 5th one was seen; on 6th a large pink specimen was taken, measuring 102 mm. in diameter. Over thirty specimens seen on November 7th; too deep to catch. These were all pink, and from two to four inches in diameter.
Another on November 9th and two on the 15th; probably all part of the same shoal.
The two captured on 15th measured, respectively, 120 mm. in diameter, 65 canals, 64 tentacles, one to three bulbs, and one to five vesicles between every two tentacles; and 75 mm. in diameter, 63 canals, 52 tentacles, one to two bulbs, and three or more vesicles between the tentacles. Both were pink in colour.

Saphenia mirabilis (Wright).

1899.—One small specimen on July 4th, and a very young stage on August 21st.

1900.—One on June 15th and one on 26th. A few young stages early in July, and some large ones on 28th. One in August.

1901.—A very small one on April 26th was the only one seen.

TRACHOMEDUSAE.

Aglantha rosea (Forbes).

1900.—A very small one on July 18th, two on the 19th, and two on the 26th of same month.

1901.—One only was seen on May 19th.

Gossea circinata, Haeckel.

1899.—This medusa appears late in the autumn. Two were captured on September 2nd, and one on November 21st.

1900.—None seen.

1901.—A number seen on November 6th, 7th, and 8th, and a number also on 29th. One measured 16 mm. wide and 10 mm. high; two short tentacles between the groups.

Glossocodon sp. ?

1901.—On November 15th two medusae were captured, belonging to the genus *Glossocodon*. They had four long per-radial tentacles and four short inter-radial ones curled up round the outside of the umbrella. The medusa is quite colourless, and rather like an Octorchis in appearance.

On November 29th a number were taken in the tow-net, and several more by hand; in all about thirty specimens.

Some of these were measured. The smallest, with eight tentacles, was 5 mm. in diameter; three others, measuring 12, 14, and 15 mm. respectively, had each four tentacles.

NARCOMEDUSAE.

Solmaris corona (Keferstein et Ehlers).

1899.—Only three specimens in August.

1900.—A few in July; common all through August and September. One very small one measured 2 mm. in diameter, 14 tentacles, and 5 vesicles.

1901.—A few in July and September. Extremely abundant all through November.

ACRASPEDA.

Discomedusae.

Aurelia aurita, Linn.

1899.—On February 20th an Ephyra stage of *Aurelia* was taken.

A large one seen on May 25th; common all June; some measured 10 inches in diameter.

1900.—One Ephyra on March 5th and three on March 30th; no adult specimens seen.

1901.—Three Ephyrae on February 14th; one on March 16th. Three were kept alive in a bell jar for several weeks until they had nearly reached the adult form.
A number of large specimens in May; very abundant in June and July.

Chrysaora isosceles (Linn).

1899.—Two small ones on May 15th; others on 16th.
A number of large ones on June 13th; another large shoal on June 14th. Abundant all through June; a few in July and August. From one of these large medusa captured in June, a number of Scyphistomae were reared and kept alive until the following spring. In April they gave off a number of Ephyrae. One was successfully reared to the adult stage, measuring at its best nine inches in diameter.

1900.—One seen on August 20th.

1901.—One seen on May 21st; common all through June and July.

Cyanea Lamarcki, Péron et Lesueur.

1899.—A young specimen taken April 26th, with only seven lobes instead of the normal eight, and seven sense-organs. A very small one on May 9th, measuring only 16 mm. in diameter.
On August 4th a number of very large specimens, and a few on 8th and 11th of the same month.

1900.—A shoal of very large specimens on September 1st; a great many of them broken. Ova were obtained, and Scyphistomae reared.

1901.—A good many seen in June from two to five inches in diameter. In September two damaged specimens were seen.

Pelagia perla (Slabber).

1899.—A few seen in September and October.

1900.—On July 14th a small specimen, and another in September.

[TABLES.

TABLE

MONTHLY DISTRIBUTION OF PELAGIC ANIMALS

—	1899.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Radiolaria,	–	–	–	–	–	–	–	×	×	–	–	–
Velella spirans,	–	–	–	×	–	–	–	–	–	–	–	–
Muggiaea atlantica,	–	–	–	–	–	–	–	–	–	–	–	–
Galeolaria sp. ?	–	–	–	–	×	–	–	–	–	–	–	–
Cupulita Sarsi,	×	–	–	–	×	×	×	×	×	×	×	–
Agalma sp. ?	–	–	–	–	–	–	×	–	–	–	–	–
Arachnactis Bournei,	–	–	–	–	–	–	–	–	–	–	–	–
Pleurobrachia pileus,	–	–	–	×	×	×	×	×	×	×	×	–
Bolina norvegica,	–	–	×	–	×	×	×	×	×	×	×	–
Beroe ovata,	–	–	–	–	–	×	–	×	×	–	–	–
Bipinnaria,	–	–	–	–	–	–	×	×	–	–	–	–
Pluteus,	–	–	–	–	–	–	×	×	×	–	–	–
Tomopteris onisciformis,	×	–	–	–	×	×	×	×	×	–	–	–
Sagitta bipunctata,	×	–	–	×	×	×	×	×	×	–	–	–
Ianthina communis,	–	–	–	–	–	–	–	–	–	–	–	–
Limacina retroversa,	–	–	–	–	–	–	–	–	–	–	–	–
Clione limacina,	–	–	–	–	–	–	–	–	–	–	–	–
Thalia democratica–mucronata,	–	–	–	–	×	×	–	–	–	–	–	–
Salpa runcinata–fusiformis,	–	–	–	–	–	–	–	–	–	–	–	–
Doliolum,	–	–	–	–	–	–	–	–	–	–	–	–
Oikopleura,	–	–	–	–	×	×	–	–	–	–	–	–
Noctiluca miliaris,	–	–	–	–	–	–	–	×	×	×	–	–
Actinotrocha,	–	–	–	–	–	–	–	–	–	–	–	–
Phyllosoma,	–	–	–	–	×	–	–	–	–	–	–	–
Copepods,	×	×	×	×	×	×	×	×	×	×	–	–

I,

IN VALENCIA HARBOUR FOR 1899–1901.

1900.												1901.											
January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
-	-	-	-	-	-	×	×	×	×	-	-	-	-	-	-	-	-	-	×	×	×	-	-
-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-
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-	-	-	×	-	-	×	-	-	-	-	-	-	-	-	×	×	×	-	-	-	-	×	-
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-	-	×	×	×	×	×	×	×	×	-	-	-	×	×	×	×	×	×	×	×	×	×	-

TABLE

MONTHLY DISTRIBUTION OF MEDUSAE IN

	1899.											
—	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Amphinema dinema,	–	–	–	–	×	×	×	×	×	–	–	–
Corymorpha nutans,	–	–	–	×	×	×	×	×	×	–	–	–
Cytæandra areolata,	–	–	–	–	×	–	–	×	–	–	–	–
Dipurena ophiogaster,	–	–	–	–	×	×	×	–	×	–	–	–
,, halterata,	–	–	–	–	–	×	×	–	–	–	–	–
Ectopleura Dumortieri,	–	–	–	×	×	×	×	×	–	–	–	–
Euphysa aurata,	–	–	–	×	×	×	×	×	–	–	–	–
Hybocodon prolifer,	–	–	×	–	×	–	–	–	–	–	–	–
Lar sabellarum,	–	–	×	×	×	–	×	×	×	–	–	–
Lizzia blondina,	–	–	–	–	–	–	–	–	–	–	–	–
Margelis,	–	–	–	×	×	×	×	×	–	–	–	–
Margelium octopunctatum,	–	×	×	×	×	×	–	×	×	–	–	–
Sarsia gemmifera,	–	–	–	–	–	–	–	–	–	–	–	–
,, prolifera,	–	–	–	–	×	×	×	×	–	–	–	–
,, tubulosa,	–	–	–	–	×	×	×	×	–	–	–	–
Tiara pileata,	–	–	×	×	×	×	×	×	×	–	–	–
Gemmaria implexa,	–	–	–	–	–	–	–	–	–	–	–	–
Agastra caliculata,	–	–	–	–	–	–	–	×	–	–	–	–
Dipleurosoma typicum,	–	–	–	–	×	×	×	×	×	–	–	–
Euchilota pilosella,	–	–	–	×	×	×	–	×	–	–	–	–
Entima insignis,	–	–	–	–	–	–	–	–	–	–	–	–
Laodice calcarata,	–	–	–	–	×	×	×	×	×	–	–	–
Melicertidium octocostatum,	–	–	–	–	–	–	–	–	–	–	–	–
Obelia nigra,	–	–	×	×	×	×	×	×	×	–	–	–
Octorchis Gegenbauri,	–	–	–	–	–	–	–	–	×	–	–	–
Phialidium cymbaloideum,	–	–	×	×	×	×	×	×	×	–	–	–
,, temporarium,	×	×	×	–	×	×	×	×	×	–	–	–
,, buskianum,	–	–	–	–	–	–	×	×	×	–	–	–
Polycanna forskalea,	–	–	–	–	×	–	–	×	–	–	–	–
Saphenia mirabilis,	–	–	–	–	–	–	×	×	–	–	–	–
Aglantha rosea,	–	–	–	–	–	–	–	–	–	–	–	–
Gossea circinata,	–	–	–	–	–	–	–	–	×	–	×	–
Glossocodon sp. ?	–	–	–	–	–	–	–	–	–	–	–	–
Solmaris corona,	–	–	–	–	–	–	–	×	–	–	–	–
Aurelia aurita,	–	×	–	–	×	×	–	–	–	–	–	–
Chrysaora isosceles,	–		–	–	×	×	×	–	–	–	–	–
Cyanea Lamarcki,	–	–	–	×	×	–	–	×	–	–	–	–
Pelagia perla,	–	–	–	–	–	–	–	–	×	×	–	–

II.

VALENCIA HARBOUR FOR 1899–1901.

1900.												1901.											
January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
-	-	-	-	-	×	×	×	×	-	-	-	-	-	×	-	×	-	-	×	-	-	×	-
-	-	-	×	×	×	-	×	-	-	-	-	-	-	-	×	×	×	-	-	-	×	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	×	×	×	-	-	-	-	-	-	-
-	-	-	-	×	×	×	×	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-
-	-	-	-	-	-	×	×	×	×	-	-	-	-	-	-	-	-	-	-	-	-	×	-
-	-	-	-	×	×	×	×	×	×	-	-	-	-	-	×	×	×	×	×	×	-	-	-
-	-	-	×	×	×	×	×	-	-	-	-	-	-	-	×	×	×	×	-	-	-	-	-
-	-	-	×	×	-	-	-	-	-	-	-	-	-	-	×	×	-	-	-	-	-	-	-
-	-	-	-	-	×	×	×	×	×	-	-	-	×	×	×	-	×	×	×	×	×	×	-
-	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-
-	-	×	×	×	×	×	×	×	-	-	-	-	-	-	×	×	×	-	-	-	-	-	-
-	-	×	×	×	×	×	×	×	-	-	-	-	×	-	×	-	×	-	-	×	×	-	-
-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	×	×	×	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	×	×	×	-	-	-	-	-	-	-	-	×	×	×	×	-	×	×	-	-
-	-	-	-	×	×	×	×	×	×	-	-	-	-	-	×	×	×	×	×	×	-	×	-
-	-	-	-	-	×	×	-	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-
-	-	-	-	-	×	×	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	×	×	×	×	×	-	-	-	-	-	-	-	×	×	×	-	×	-	-	-
-	-	-	-	×	×	×	×	×	-	-	-	-	-	-	-	×	×	-	-	-	-	-	-
-	-	-	-	-	×	×	×	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	×	×	×	×	-	-	-	-	-	-	×	×	×	-	×	×	-	×	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-
-	-	×	×	×	×	×	×	×	×	-	-	-	-	-	×	×	×	×	×	×	×	×	-
-	-	-	-	-	-	×	×	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	×	×	×	×	×	×	×	-	-	-	-	-	×	×	×	×	×	×	×	×	-
-	-	×	×	×	×	×	×	×	-	-	-	-	×	×	×	×	×	×	×	×	×	×	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-
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-	-	×	-	-	-	-	-	-	-	-	-	-	×	×	-	×	×	×	-	-	-	-	-
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-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	×	-	-	×	-	-	-
-	-	-	-	-	-	×	-	×	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ii.—NOTES ON THE REARING, IN AN AQUARIUM, OF *CYANEA LAMARCKI*, Peron et Lesueur.

BY

M. J. Delap.

Plates I. and II.

On September 1st, 1900, a large shoal of *Cyanea Lamarcki* appeared in Valencia Harbour. The medusae were of a very deep blue colour, which looked almost black in certain lights.

The upper parts of the oral arms were of a yellowish colour, shading off into white at the extremities. Several of the largest specimens measured nine inches in diameter.

One large specimen was placed for a short time in a tank, where it deposited thousands of eggs, which looked just like little yellow grains of sand. Three days later some of the eggs developed into ciliated planulae, and swam about in a most active manner.

About September 10th, the planulae commenced to settle down on the bottom and on the sides of the aquarium, and also to hang down from the surface-film of the water.

Ten days later some of the planulae had reached the scyphistoma stage, and begun to develop tentacles. At first there were only four tentacles, but soon other tentacles made their appearance, usually one at a time.

On September 20th, the largest scyphistoma had eight tentacles, and measured about $\frac{1}{2}$ mm. in width and nearly 1 mm. in height; the tentacles included in the measurement.

After the swarm of planulae had fixed themselves, their rate of development showed considerable variation.

Only a few developed rapidly, and these became during the winter fully grown scyphistomae, and strobilized in the following spring.

The majority remained in a dormant condition and did not produce tentacles until they were several months old, and then only four or eight tentacles. They remained in this condition over a year and have not yet strobilized.

Two of the largest and most vigorous scyphistomae settled down on the side of the bell-jar, in a good position for daily observation.

During the winter they lived upon copepods, sagittae, and small hydromedusae, but the copepods were preferred and formed their chief food supply.

These two scyphistomae slowly increased in size, and gradually increased the number of their tentacles. One, on October 8th, had seventeen tentacles; on October 17th, twenty-one tentacles; on October 29th, twenty-four tentacles, and reached its maximum number of tentacles—twenty-eight—on January 21st, 1901; about a month before strobilization. The other one did not attain its maximum number—twenty-four—until February 1st, and only ten days before strobilizing.

On February 24th the largest scyphistoma commenced to strobilize. It then measured 2 mm. in width and 4 mm. in height. The tentacles when fully expanded were about 20 mm. in length.

The first ring or segment appeared just below the tentacles. A second segment appeared the next day, and a daily increase occurred until March 5th, when the strobila had nine segments. The seven uppermost segments had scalloped edges—the commencement of the arms belonging to the Ephyra stage. At this stage the marginal tentacles belonging to the scyphistoma stage began to alter their position, and to disappear. Whilst the uppermost segment was developing into an Ephyra, some of

the marginal tentacles shifted into the following positions:—One on each of the eight arms of the future Ephyra, just above the sense organ, and one midway between every two arms; so that sixteen tentacles remained on the margin of the young Ephyra.

The other tentacles were pushed in towards the mouth, and formed isolated groups.

All these tentacles belonged to the scyphistoma, and after taking up these positions, began to slowly disappear by absorption.

They became smaller and smaller until only tiny knobs were left.

The knobs remained on the free-swimming Ephyra until it was nine days old, when they finally disappeared.

On March 8th, the strobila had eleven segments, and two days later the upper five had developed into fully-grown Ephyrae ready for liberation; the arms, bearing the sense-organs, were in motion, flapping vigorously in their efforts to get free.

The strobila had now reached its maximum growth, and measured 3 mm. in diameter, and 6 mm. in height.

The next day, March 12th, two Ephyrae were liberated, and three more on the following day. The Ephyra of *Cyanea*, at the time of its liberation, is larger (4 mm. in diameter) than that of *Chrysaora*—about twice the size—and its colour is white whereas *Chrysaora* is quite pinkish in colour.

By March 15th, the strobila had set free ten Ephyrae, and two more were nearly ready for liberation.

It now commenced to grow a fresh set of tentacles, just below the twelfth segment.

On March 18th, the last two Ephyrae were liberated, and strobilization completed. The strobila now reverted again to the scyphistoma stage. Marginal tentacles quickly appeared, and in July it had thirty-three tentacles—five more than in the previous year.

This scyphistoma started to strobilize again on January 17th, 1902, exactly ten months after liberating its first batch of Ephyrae. It liberated eight Ephyrae early in February, thus producing twenty Ephyrae in eleven months.

The free-swimming Ephyrae were placed in a bell-jar, and given a good food supply, consisting of copepods and very small Hydromedusae, which they began to eat at once.

By March 21st, the largest Ephyra had lost all traces of the scyphistoma tentacles, and had two new opposite bulbs, from one of which a tentacle commenced to develop three days later.

On April 5th, the Ephyrae were placed in a large bell-jar (10 inch).

Each had one long tentacle and one large bulb opposite to it; also very minute bulbs between the arms.

The largest specimen then measured 7 mm. in diameter.

On April 15th, the largest measured 10 mm. in diameter, and had two long opposite tentacles and large bulbs between the arms.

The longest tentacle had also minute bulbs adjacent to it, one on each side—the commencement of a group of tentacles.

On April 24th, there were four long per-radial tentacles and four large inter-radial bulbs, and also smaller bulbs adjacent to the tentacles and the large inter-radial bulbs.

On the 30th it measured 20 mm. in diameter, and had eight long tentacles, and the oral arms or frills were well developed.

These arms are shorter and broader than these of *Chrysaora*, and are less frilled along the margin.

On May 9th, the specimen measured 30 mm. in diameter, and had now several tentacles, varying in length in each of the eight groups.

For several weeks this specimen did not grow much, and when it died on June 4th, it only measured 50 mm. in diameter.

Though so small, it had quite reached the adult form, and the umbrella was of a deep blue colour.

Another medusa grew more rapidly, as it measured 50 mm. on May 29th and about 80 mm. on June 10th. The umbrella was a very deep blue, the oral arms yellowish white, and the tentacles pinkish.

This specimen remained alive some weeks longer, but as it was gradually decreasing in size, it was finally transferred to a solution of formaline.

Cyanea does not thrive in captivity as well as *Chrysaora*. It evidently requires more space than is given in an ordinary bell-jar of ten inches in diameter. It would remain for hours motionless on the bottom, and would not swim even to catch its food; but if a medusa was placed inside the frills, it quickly disappeared into the stomach.

When first liberated, the Ephyrae fed on small copepods, small medusae, and fish eggs, especially the latter, which are plentiful in the townet at that time of year.

When the weather was too wild for townetting, the young *Cyanea* lived on small *Sarsia tubulosa*, hatched in an aquarium. These formed a valuable food reserve.

Later on *Cyanea* lived entirely upon jellyfishes, especially the Hydromedusae of the genera *Phialidium*, *Euchilota*, *Laodice*, *Obelia*, and *Corymorpha*; the latter were greedily devoured.

Of the Ctenophores, *Bolina* was preferred, but sometimes *Pleurobrachia* were eaten, and also very small *Beroe*.

Tiara pileata, and large *Sarsia tubulosa* and large *Beroe* were objected to, and never eaten.

TABLE OF TEMPERATURES.

Date.			Air in Room.	Aquaria.	Surface Temp. Sea.
September,	...	1900,	F. 60°—63·5°	F. 59° — 63°	F. 58°—59°
October,	... ...	„	54 —60	53 —58	53 —57
November,	... ...	„	49 —60	49 —59	48 —56
December,	... ...	„	54 —58	53 —56	49 —52
January,	... ...	1901,	44 —55	45 —53	45 —50
February,	... ...	„	46 —55	44·5—52	46 —47·5
March	... ...	„	49 —56	47·5—54	47 —53
April,	... ...	„	52 —59	51 —57	48 —51
May,	... ...	„	57 —64	56 —62	50·5—53·5
June,	... ...	„	60 —68	54 —64	55 —56

EXPLANATION OF PLATES I. AND II.

Cyanea Lamarcki, Peron et Lesueur.

Plate I., Figs. 1 and 2, Ephyra, three weeks old - × 4
Fig. 3, *Cyanea*, seven weeks old - - × 4

Plate II., Fig. 1, Strobila - - - - × 16
Fig. 2, Ephyra - - - - × 20

APPENDIX, No. II.

REPORT ON THE COPEPODA OF THE ATLANTIC SLOPE OFF COUNTIES MAYO AND GALWAY.

BY

G. P. FARRAN, B.A.

PLATES III.—XIII.

i.—INTRODUCTORY.

During the summer of 1901 the S.S. "Helga" made two expeditions into moderately deep water off the west coast of Ireland, and brought back several townettings containing a large supply of Copepoda. The first of these expeditions was to the Porcupine Bank, which lies 100 miles true west of Co. Galway, and rises to within 85 fathoms of the surface.

The bearings of the positions on the Bank where the collections were made, and the symbols by which they are distinguished in the following pages, are as follows:—

PORCUPINE III.—Lat. 53° 24′ N., Long. 13° 34′ W., 29th June, 1901.

(*a*.) Medium silk townet—surface.
(*b*.) Medium silk townet—50 fath.
(*c*.) Medium silk townet—100 fath.
(*d*.) Coarse silk townet above Naturalist's dredge—91 fath.

PORCUPINE IV.—Lat. 53° 23′ N., Long. 13° 12′ W., 29th June, 1901.

Coarse silk townet above Naturalist's dredge—120 fath.

PORCUPINE V.—Lat. 53° 23′ N., Long. 12° 43′ W., 29th June, 1901.

(*a*.) Medium and coarse silk townets—surface.
(*b*.) Medium and coarse silk townets—90 fath.
(*c*.) Medium and coarse silk townets—175 fath.

The Porcupine Bank is connected with the mainland by a narrow neck, the greatest depth of water on which is 185 fathoms. To the south of this neck, and lying between the Bank and the mainland, is an ocean valley

with comparatively steep sides and a general north and south direction, which descends to a depth of over 1,000 fathoms. On the north side the connecting neck slopes rather abruptly into deep water. It was on the northern slope of this connecting ridge, about 50 miles true west of Achill Head, Co. Mayo, that the collections of the second expedition were made.

The bearings of the stations of the second expeditions and the collections made on them were as follows:—

HELGA CXX.—Lat. 53° 58′ N., Long. 12° 28′ W., 24th Aug., 1901.

Medium silk townet, *ca.* 200 fath.
Townets attached to trawl—382 fath.

HELGA CXXI.—Lat. 53° 52′ N., Long. 11° 56′ W., 24th Aug., 1901.

Townets attached to trawl—199 fath.

The two nets used on both expeditions were of the ordinary open ring pattern.

The number of species taken were:—

Calanidae,	45
Centropagidae,	17
Candaciidae,	1
Pontellidae,	1
Cyclopidae,	2
Harpacticidae,	3
Oncaeidae,	2

Of these the following thirteen species have been described as new:—*Bradyetes inermis*, *Bryaxis minor*, *Gaetanus Holti*, *Gaetanus minor*, *Scolecithrix emarginata*, *Scolecithrix ovata*, *Scolecithrix echinata*, *Xanthocalanus Greeni*, *Xanthocalanus pinguis*, *Xanthocalanus obtusus*, *Oöthrix bidentata*, *Lucicutia curta*, *Aegisthus spinulosus*.

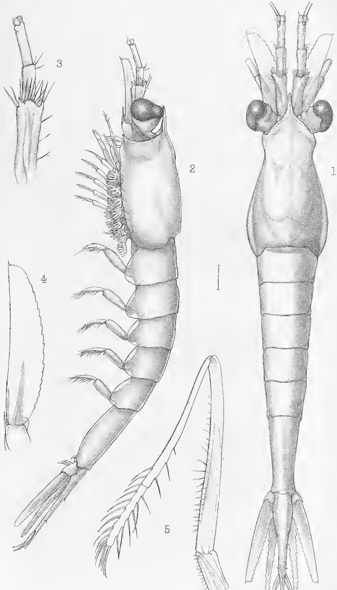
Two new genera, Bradyetes and Oöthrix, have been instituted for two of the above species.

The most noticeable feature of the collection is the large number of bottom-haunting forms which were obtained by means of townets attached to the trawl. It was by this means that the majority of the new species described below were caught, and it is probable that large additions to the number of oceanic Copepoda may be looked for in the future by the employment of this method.

One of the townets attached to the trawl at station Helga CXXI., came up filled with muddy sand, which, when washed, yielded the following species:—*Bradyidius armatus* (in large numbers), *Bryaxis brevicornis*, *Aetideus armatus*, *Chiridius armatus*, *Xanthocalanus borealis*, *Oöthrix bidentata*, *Pleuromamma robusta*, thus emphasising their bottom-loving habit.

Most of the species mentioned in this paper have been already recorded from the Atlantic, but three of them have, as far as I know, only been taken previously in the Pacific, viz., *Undeuchaeta major*, *Euchaeta tonsa*, and *Metridia venusta*, though the last may possibly be identical with *M. Normani*. Of the rest, omitting some doubtful records, thirty seem to be universally distributed, seven have been recorded from the Atlantic and Mediterranean, and fifteen from the Atlantic only. The collection may be regarded as fairly typical of the N.E. Atlantic Copepod fauna, as may be seen by comparing it with the list published by the late Mr. I. C. Thompson from the "Oceana" collection.* The "Oceana" townettings were taken a little further south and in very much deeper water; and although the number of townettings taken and species recorded is much larger, yet the correspondence between the families and genera and, to a large extent, between the species of the two lists, is very marked.

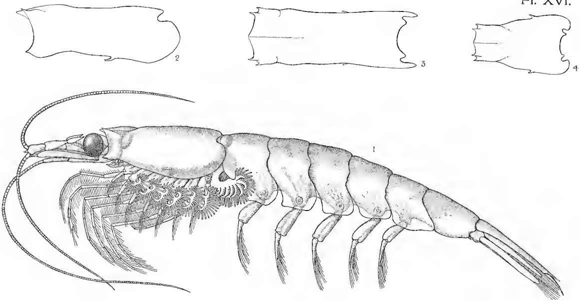
* *Ann. and Mag. N. Hist.*; Ser. 7. Vol. xii.



E. W. L. Holt del.
G. M. Woodward lith.

West, Newman imp.

Thysanoessa longicaudata



G. M. Woodward del.

Meganyctiphanes norvegica.

It is only after a prolonged series of investigations, such as those here recorded that we can begin to form some idea of the nature of the fauna which exists in the deeper waters which surround our coasts. The rapid extension of the trawling industry in recent years, and the fact that depths, which a short time ago were practically unknown even to the naturalist with his dredge, are now called upon to contribute regularly to the markets of our cities, makes it a matter of importance that we should have some accurate knowledge of the invertebrate life of these regions, on which the fish-life ultimately depends.

The Copepoda in particular are deserving of investigation, forming as they do the principal food of most fishes in their early stages, and of many fishes throughout their life. The knowledge of the distribution of the various species, and the distinguishing of those with a universal range from those whose habitat is exclusively tropical or boreal, may serve to throw light on many doubtful points. The existence and direction of ocean currents may be indicated by the chance occurrence of species which have their centres of distribution in other waters, and as another instance of the possible usefulness of this knowledge, I may mention the occurrence of specimens of *Pleuromamma robusta* in some of the stomachs of the earliest spring mackerel to arrive off the coast of Cleggan, Co. Galway, in the spring of 1902. This copepod has never been taken on the fishing-grounds, but as these and other investigations show, it is not uncommon in the deeper waters off our western coasts.*

The capture of *Gaetanus pileatus* in a mackerel's stomach, as recorded in last year's report (*Report on Sea and Inland Fisheries of Ireland for* 1901, Pt. II., App., p. 120), is not quite a parallel instance, as that copepod was taken from a small winter mackerel.

It is to further facts and coincidences of this nature that we must look for enlightenment on that still mysterious subject which is of the utmost importance to the western counties of Ireland, the causes of the periodic arrival and disappearance of the mackerel, and it is only by the continuous collection of what may appear to most people as insignificant details that these facts can be acquired. Fortunately it is now but seldom asserted that all researches which do not admit of their results being estimated by an immediate cash equivalent are indefensible waste of time and money.

In the list which follows the nomenclature of Giesbrecht, as given in "Das Tierreich," has been used.

The symbols made use of in the table of species are:—A = abundant, C = common, M = moderate, F = few, VF = very few, × = one to three specimens.

* Another fact, brought to my notice by Mr. Holt, which seems to point to the same conclusion was that of the first four spring mackerel captured in the Blacksod Fishery, Co. Mayo, in 1899 (13th April), two had empty stomachs and the other two were crammed with large specimens of *Nyctiphanes norvegica*. Large specimens of this schizopod are not known to occur on the west coast of Ireland except at a considerable distance from land, though they are sometimes taken on the east coast.

[TABLES.

D

ii.—Table of

—	Porcupine III.A Surface.	Porcupine III.B 50 fath.	Porcupine III.C 110 fath.	Porcupine III.D Above Dredge.	Porcupine IV. Above Dredge.	Porcupine V.A Surface.
Calanus finmarchicus, ...	-	×	F	M	A	-
Cal. tenuicornis, ...	-	×	-	-	-	-
Eucal. elongatus, ...	-	×	×	VF	F	-
Eucal. crassus, ...	-	-	×	-	×	-
Rhincal. nasutus, ...	-	×	M	A	M	-
Paracal. parvus, ...	-	VF	VF	-	-	VF
Ctenocal. vanus, ...	-	×	×	-	-	-
Pseudocal. elongatus, ...	×	F	F	-	×	-
Spinocal. abyssalis, ...	-	-	×	-	-	-
Spinocal. magnus, ...	-	-	-	-	×	-
Aetideus armatus, ...	-	×	×	-	-	-
Bradyidius armatus, ...	-	-	-	VF	-	-
Bradyetes inermis, ...	-	-	-	-	-	-
Bryaxis brevicornis, ...	-	-	-	-	-	-
Bryaxis minor, ...	-	-	-	-	-	-
Gaidius tenuispinus, ...	-	-	-	-	-	-
Gaidius brevispinus, ...	-	-	-	-	-	-
Gaetanus major, ...	-	-	-	-	-	-
Gaetanus pileatus, ...	-	-	-	-	-	-
Gaetanus Holti, ...	-	-	-	-	-	-
Gaetanus minor, ...	-	-	-	-	-	-
Chiridius armatus, ...	-	-	-	-	-	-
Chiridius Poppei, ...	-	-	-	-	-	-
Undeuchaeta major, ...	-	-	-	-	-	-
Undeuchaeta minor, ...	-	-	-	-	-	-
Euchirella rostrata, ...	-	-	-	-	-	-
Euchir. curticauda, ...	-	-	-	-	-	-
Euchaeta acuta, ...	-	-	-	-	-	-
Euchaeta norvegica, ...	-	-	-	-	-	-
Euchaeta tonsa, ...	-	-	-	-	-	-
Scolecithrix dentata, ...	-	-	×	-	-	-
Scol. minor, ...	-	-	×	-	-	-
Scol. pygmaea, ...	-	-	×	-	-	-
Scol. cristata, ...	-	-	-	-	-	-
Scol. chelifer, ...	-	-	-	-	-	-

Relative Abundance.

Porcupine V.B. 90 fath. (medium).	Porcupine V.B 90 fath. (coarse).	Porcupine V.C 175 fath.	Helga CXX. 200 fath.	Helga CXX. On Trawl.	Helga CXXI. On Trawl.	—
A	A	C	-	A	A	Calanus finmarchicus.
-	-	-	-	-	-	Cal. tenuicornis.
F	M	×	-	VF	-	Eucal. elongatus.
×	×	-	-	×	×	Eucal. crassus.
×	×	×	-	×	M	Rhincal. nasutus.
×	-	VF	×	-	-	Paracal. parvus.
-	-	-	×	-	-	Ctenocal. vanus,
F	×	M	C	-	-	Pseudocal. elongatus.
-	-	-	×	-	-	Spinocal. abyssalis.
-	-	-	×	VF	×	Spinocal. magnus.
×	-	-	×	×	×	Aetideus armatus.
-	-	×	-	×	C	Bradyidius armatus.
-	-	-	-	×	-	Bradyetes inermis.
-	-	-	-	-	×	Bryaxis brevicornis.
-	-	-	-	×	-	Bryaxis minor.
-	-	-	-	×	-	Gaidius tenuispinus.
-	-	-	-	×	-	Gaidius brevispinus.
-	-	-	-	×	-	Gaetanus major.
-	-	-	-	×	-	Gaetanus pileatus.
-	-	-	-	×	-	Gaetanus Holti.
-	-	-	-	×	-	Gaetanus minor.
-	-	-	-	F	×	Chiridius armatus.
-	-	-	-	×	-	Chiridius Poppei.
-	-	-	-	×	-	Undeuchaeta major.
-	-	-	-	×	×	Undeuchaeta minor.
-	×	-	-	-	-	Euchirella rostrata.
-	-	-	-	×	-	Euchir. curticauda.
×	×	-	-	-	×	Euchaeta acuta.
-	-	-	×	VF	VF	Euchaeta norvegica.
-	-	-	-	×	-	Euchaeta tonsa.
×	-	-	×	×	-	Scolecithrix dentata.
VF	-	-	F	-	-	Scol. minor.
-	-	-	-	-	-	Scol. pygmaea.
-	-	-	-	F	-	Scol. cristata.
-	-	-	-	×	-	Scol. chelifer.

—	POR-CUPINE III.A Surface.	POR-CUPINE III.B 50 fath.	POR-CUPINE III.C 110 fath.	POR-CUPINE III.D Above Dredge.	POR-CUPINE IV. Above Dredge.	POR-CUPINE V.A Surface.
Scol. emarginata, ...	-	-	-	-	-	-
Scol. ovata, ...	-	-	-	-	-	-
Scol. echinata, ...		-	×	-	-	-
Xanthocalanus borealis, ...	-	-	-	-	×	-
Xanthocal. Greeni, ...	-	-	-	-	-	-
Xanthocal. pinguis, ...	-	-	-	-	-	-
Xanthocal. obtusus, ...	-	-	-	-	-	-
Xanthocal. sp. ? ♂ ...	-	-	-	-	×	-
Brachycal. atlanticus, ...	-	-	-	-	-	-
Oothrix bidentata, ...	-	-	-	-	-	-
Phaenna spinifera, ...	-	-	-	-	-	-
Centropages typicus, ...	-	×	×	-	-	VF
Temora longicornis, ...	-	-	-	-	-	-
Metridia lucens, ...	VF	F	F	VF	F	VF
Metridia venusta, ...	-	-	-	-	-	-
Metridia princeps, ...	-	-	-	-	-	-
Pleuromamma robusta, ..	-	-	-	-	VF	-
Lucicutia flavicornis, ...	-	-	×	-	-	-
Lucicutia curta, ...	-	-	-	-	-	-
Lucicutia atlantica, ...	-	-	-	-	×	-
Heterorhabdus spinifrons, ...	-	-	-	-	-	-
Heteror. norvegicus, ...	-	-	-	-	-	-
Heteror. abyssalis, ...	-	-	-	-	VF	-
Heteror. vipera, ...	-	-	-	-	-	-
Heteror. longicornis, ...	-	-	-	-	-	-
Haloptilus longicornis, ...	-	-	-	-	-	-
Halop. acutifrons, ...	-	-	-	-	×	-
Phyllopus bidentatus, ...	-	-	-	-	-	-
Candacia norvegica, ..	-	-	-	-	-	-
Acartia Clausi, ...	F	A	A	×	VF	A
Oithona similis, ...	M	VF	VF	-	×	×
Oithona plumifera, ...	-	F	VF	-	×	-
Microsetella atlantica, ...	-	×	-	-	-	-
Aegisthus mucronatus, ...	-	-	-	-	×	-
Aegisthus spinulosus, ...	-	-	-	-	-	-
Oncaea conifera, ...	-	×	F	-	×	×
Oncaea rapax, ...	-	-	×	-	-	-
Idya furcata, ...	-	-	-	-	-	-

ABUNDANCE—*continued.*

PORCUPINE V.B 90 fath. (medium).	PORCUPINE V.B. 90 fath. (coarse).	PORCUPINE V.C 175 fath.	HELGA CXX. 200 fath.	HELGA CXX. On Trawl.	HELGA CXXI. On Trawl.	—
-	-	-	-	VF	-	Scol. emarginata.
-	-	-	-	×	-	Scol. ovata.
-	-	-	-	-	-	Scol. echinata.
-	-	-	-	F	F	Xanthocalanus borealis.
-	-	-	-	×	-	Xanthocal. Greeni.
-	-	-	-	×	-	Xanthocal. pinguis.
-	-	-	-	×	-	Xanthocal. obtusus.
-	-	-	-	-	×	Xanthocal. sp.? ♂
-	-	-	-	-	×	Brachycal. atlanticus.
-	-	-	-	(×)	×	Oöthrix bidentata.
×	-	-	-	×	-	Phaenna spinifera.
×	×	×	-	-	-	Centropages typicus.
-	-	-	×	-	-	Temora longicornis.
M	F	-	M	F	M	Metridia lucens.
-	-	-	-	VF	-	Metridia venusta.
-	-	-	-	×	-	Metridia princeps.
VF	×	-	-	F	F	Pleuromamma robusta.
-	-	-	-	-	-	Lucicutia flavicornis.
-	-	-	-	×	-	Lucicutia curta.
-	-	-	-	-	-	Lucicutia atlantica.
-	-	-	-	×	-	Heterorhabdus spinifrons.
-	-	-	-	VF	VF	Heteror. norvegicus.
-	-	-	-	F	-	Heteror. abyssalis.
-	-	-	-	VF	-	Heteror. vipera.
-	-	-	-	×	-	Heteror. longicornis.
-	-	×	-	-	-	Haloptilus longicornis.
-	-	-	-	-	-	Halop. acutifrons.
-	-	-	-	×	-	Phyllopus bidentatus.
-	-	-	-	×	-	Candacia norvegica.
F	×	A·	C	-	×	Acartia Clausi.
×	×	VF.	-	-	-	Oithona similis.
×	×	×	-	-	-	Oithona plumifera.
-	×	-	-	-	-	Microsetella atlantica
-	-	-	-	-	-	Aegisthus mucronatus.
-	-	-	-	×	-	Aegisthus spinulosus.
×	-	F	VF	-	-	Oncaea conifera.
-	-	-	-	-	-	Oncaea rapax.
-	-	-	-	-	×	Idya furcata.

iii.—LIST OF SPECIES.

CALANIDAE.

Calanus finmarchicus, (Gunn.).

Scarce at Porcupine III. except at the bottom; plentiful in the middle and bottom nets at Porcupine V., and apparently absent from Helga CXX., except when stirred up from the bottom by the trawl. In size these specimens, all ♀, agree with Sars' *C. heligolandicus*, the average length being 3·1. The outline of the head and the proportions of the furca are, however, intermediate between *C. heligolandicus* and *C. finmarchicus*, as figured by G. O. Sars,* as is also the case with most specimens from the west coast of Ireland.

Calanus tenuicornis, Dana.

Two specimens, ♀, occurred in mid-water net at Porcupine III.

Eucalanus elongatus (Dana.).

Common throughout the Porcupine collection; occurred sparingly at Helga CXX. in tow-nets on trawl, and not at all at Helga CXXI.

Eucalanus crassus, Giesbr.

Was found in small numbers at both Porcupine and Helga CXX., CXXI. stations.

Rhincalanus nasutus, Giesbr.

Common at Porcupine III. and IV., scarce at Porcupine V., and only in the townets on the trawl at Helga CXX. and CXXI.

Paracalanus parvus (Cls.).

Found in most of the Porcupine townettings, but only in the middle net at Helga CXX.

Ctenocalanus vanus, Giesbr.

In very small numbers in the mid-water nets at Porcupine III. and Helga CXX. stations.

Pseudocalanus elongatus (Boeck).

Occurred in small numbers all through the collection, except in the townets on the trawl at stations Helga CXX. and CXXI.

Spinocalanus abyssalis, Giesbr.

Single specimens, ♀, in mid-water-nets at Porcupine III. and Helga CXX.

Spinocalanus magnus, Wolfenden.

(Pl. III., Figs. 1-12).

Length ♀ 2·9, ♂ immature 2·1 mm.

Female—Ceph. imperfectly separated from Th. 1. Th. 4 separated from Th. 5. Rostrum absent. Ceph. much more vaulted than in *S. abyssalis*. Th. 5 produced laterally into rounded lobes, reaching nearly to middle of gen. seg., sometimes bearing a tuft of ventrally-directed hairs, as found in some species of Euchaeta.

* *Crustacea of Norway*, Vol. IV. Copepoda, Pl. I.-IV.

Abdomen with four segments. Gen. seg. with strongly-developed ventral protuberance. Furcal rami slightly asymmetrical, the right one being somewhat larger and bearing a much enlarged 3rd seta.

1st Antenna (Pl. III., Fig. 3) had, in all the specimens obtained, lost about half its length, but would probably reach a little beyond the furca.

2nd Antenna (Pl. III., Fig. 4) with endop. nearly as long as exop., differing in this respect from *S. abyssalis.*

Mandible (Pl. III., Fig. 5), as in *S. abyssalis.*

Maxilla (Pl. III., Fig. 6).

1st Maxillipede (Pl. III., Fig. 7) resembles that in *S. abyssalis.*

2nd Maxillipede (Pl. III., Fig. 8) comparatively shorter than in *S. abyssalis,* with setae on outer edge of joints 5 and 6 strongly developed and feathered, as in Calanus.

All the swimming feet (Pl. III., Fig. 9--12) are somewhat stouter than in *S. abyssalis,* but agree in jointing and number of setae.

2nd foot (Pl. III., Fig. 10) with a curved row of strong spinules across lower face of 2nd joint of endop. ; a row of spinules, slightly smaller, on 2nd and 3rd joints of exop.

3rd foot (Pl. III., Fig. 11) with transverse row of spinules on 2nd and 3rd joints of both exop. and endop., those on the endop. being the larger.

The basal joint of 4th foot (Pl. III., Fig. 12) has a row of long slender spinules, running from its inner edge half-way across the lower face of the joint.

5th feet absent.

A single specimen of the male was obtained, but being immature was not examined in detail. In general configuration it approached the female very closely.

This species is separated by both size and details of structure from *S. abyssalis,* as also from *S. Schaudinii,** if that form is specifically distinct.

It occurred in small numbers in the mid-water tow-net at Helga CXX., and more plentifully in tow-nets on trawl at Helga CXX. and CXXI. A single example was found in tow-nets on trawl at Porcupine IV.

[Since the above went to press this species has been described by Dr. Wolfenden,† and here appears under the name given by him.]

Aetideus armatus, Brady.

In small numbers in the mid-water nets at Porcupine III. and V. and Helga CCX., and also in the townets on trawl at Helga CXX and CXXI. The specimens were mostly females, but a very few males were also found.

Bradyidius armatus, Vanhöffen=Undinopsis Bradyi, G. O. Sars.

Females plentiful and males moderately common in a sample of fine muddy sand brought up by one of the townets on the trawl at station Helga CXXI. They were by far the most abundant copepod in this sample.

A few specimens also occurred at Porcupine III. and V. and Helga CXX.

Genus Bradyetes, n. gen.

This genus is very closely allied to Bradyidius, Giesbr. (Undinopsis, G. O. Sars), differing chiefly in the absence of a rostrum and of acute terminations to the 5th thoracic segments.

Cephalon imperfectly separated from 1st thoracic segment, deeply inflexed in lateral margin, as in Bryaxis, thoracic segments 4--5 coalesced, their posterior margin rounded. 1st antennae very strongly setose; 2nd antennae with exop. longer than endop. Other appendages as in Bradyidius. 5 feet absent in female.

* Mzarek—*Arktische Copepoda* in Römer and Schaudin, *Fauna Arctica,* p. 509.

† *Jour. Mar. Biol. Assoc.,* N. S. Vol. VII. No. 1, April, 1904, p. 118.

Bradyetes inermis, n. sp.

(Pl. III., Figs. 13-20; Pl. IV., Figs. 13-14).

Length, female, 2·57 mm. Male unknown.

Cephalothorax, ovate elongate. Abdomen of four segments, in the proportion 6 : 4 : 3 : 2. Furcal rami slightly longer than broad.

1st Antennae (Pl. III., Fig. 15) 24-jointed, very setose, reaching to middle of genital segment. Length of joints in ·01 mm. :—

1.	2	3.	4.	5.	6.	7.	8	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
12.	14.	7.	6.	6.	6.	6.	11.	6.	7.	8.	9.	10.	10.	10.	10.	10.	10.	10.	10.	8.	12.	10.	5.

Strong ringed setae on joints 1, 2, 7, 13, 17, 20, 21, 22, 23, and 24.

2nd Antennae (Pl. III., Fig. 16) with exop. 1¼ times as long as endop., the last joint being very long and slender; two papillae on 1st joint and one on 2nd joint, each bearing a small seta.

Maxilla (Pl. III., Fig. 17) with very small exopodite.

2nd Maxillipede (Pl. III., Fig. 18) with the last five joints very short, measuring together about ⅓ of 2nd joint; 4th and 5th joints of about equal length.

1st foot (Pl. III., Fig. 19) with very large distal outer edge spine on 2nd joint of exop.; 3rd joint rather long in proportion to its width.

2nd to 4th feet (Pl. III., Fig. 20; Pl. IV., Figs. 13--14) with setae and jointing as in Bradyidius; very long and slender. Terminal spines of exopod., long, narrow, and finely denticulate.

A single female was found in townets on trawl at station Helga CXX.

Bryaxis brevicornis, G. O. Sars.

Two specimens, females, found along with *Bradyidius armatus* in muddy sand from station Helga CXXI.

Bryaxis minor, n. sp.

(Pl. IV., Figs. 1–5, 7–12).

Length, female, 1·6 mm. Male, unknown.

Cephalothorax, robust ovate. Cephalon joined to Th. 1. Th. 4 separated from Th. 5., the latter ending in a hooked projection directed dorsally, as in *B. brevicornis*.

Abdomen with four segments, short and stout. Genital seg., equal to the two succeeding segments. Furcal rami as broad as long.

1st Antenna (Pl. IV., Fig. 3), 24-jointed, very setose, reaching to beginning of Th. 4. Length of antennal joints in ·01 mm. :—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24
10.	6.	2·5.	2·5.	2·5.	2·5.	2·5.	5.	3.	3.	3.	6.	6.	6.	6.	6.	6.	6.	5.	4.	3.	7.	4.	3.

2nd Antenna (Pl. IV., Fig. 4) with outer branch very short. The terminal joint is longer than the 2nd, and bears three well-developed setae. The setae on joints 3 to 6 are very slender. It differs in this respect from that of *B. brevicornis* (Pl. IV., Fig. 6), which has strong setae on 3rd to 6th joints, and slender terminal ones on the very small 7th joint.

Maxilla (Pl. IV., Fig. 7) as in *B. brevicornis*.

1st Maxillipede (Pl. IV., Fig. 8) with strong setae on all the lobes; a strong curved spine on lobe 5, and a longer but more slender spine on lobe 4. Lobes 1 to 4 bear each a few very stout terminal spinules.

2nd Maxillipede (Pl. IV., Fig. 9) resembles that of *B. brevicornis*; the sensory appendage on the end of the 1st joint was not observed.

Feet 1--4 (Pl. IV., Figs. 10-12) closely resemble those of *B. brevicornis*.

Three specimens of this form, all females, were found at Helga CXX. in the tow-nets on the trawl. This species comes very close to *B. brevicornis*, and is separated mainly by the difference in size and in proportions of the 2nd antenna, both of which points seem to be constant.

Gaidius tenuispinus, G. O. Sars.

Four specimens, females, $l=3{\cdot}2$ mm., which seem to be referable to this species, occurred in the townets on trawl at Helga CXX. They differed slightly in some respects from the form figured by G. O. Sars; the thoracic spines were scarcely so long, and the segmentation between the 1st and 2nd joint of the exop. of 1st foot, and between the 1st and 2nd joint of the endop. of 2nd foot, was not so distinctly marked. In both these points, as also in size, they approximated somewhat to *G. pungens*.

They also possessed the lamelliform spines on the 1st basal of 4th foot.

Gaidius brevispinus, G. O. Sars.

A single specimen, a female, showing immature segmentation of the abdomen, $l=3$ mm., occurred in the townets on trawl at Helga CXX.

The spines and jointing of the feet were as in *G. brevispinus*, and the 2nd mxp. had a lamellar appendage on 1st joint and fine serrulations on the proximal part of the upper edge of the 2nd joint.

Gaetanus major (Wolfenden).

Two specimens, a female, $l=4{\cdot}7$ mm., and an immature male, $l=4{\cdot}3$ mm., occurred in townets on trawl at station Helga CXX. Dr. Wolfenden, to whom I submitted drawings of the animal, has kindly confirmed my identification of these specimens with the species described by him.

Gaetanus pileatus (Farran).

Two immature females, $l=4{\cdot}6$ mm., and an immature male, $l=3{\cdot}5$, were found in the townets on trawl at Helga CXX., which, in spite of the difference in size, seem to be referable to the above species. The possession of a 2-jointed exop. by the 1st foot serves to distinguish them from *G. caudani*.

Gaetanus Holti, n. sp.

(Pl. VI., Figs. 1–12).

Length, female, 5·1 mm. Male unknown.

Body (Pl. VI., Figs. 1–2) very robust. Ceph. joined to Th. 1. Th. 4 and Th. 5 are fused and produced backwards on either side into a long slender process starting from the ventral margin, and reaching to the end of the genital segment.

Abdomen of four segments. Genital seg. slightly broader than long, ventrally swollen, longer than the two succeeding segments; 2nd, 3rd, and anal segments of about equal length. Furcal rami slightly broader than long.

1st Antenna (Pl. VI., Fig. 3) 23-jointed, reaching to furca.

Length of antennal joints in ·01 mm.:—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24
24.	18.	12.	13.	16.	16.	16.	26.	14.	16.	16.	28.	28	27.	25.	25.	25.	32.	30.	24.	32.	28.	28.	8.

2nd Antenna (Pl. VI., Fig. 4) with two papillae on 2nd joint of exop., each with a short seta.

Mandible (Pl. VI., Fig. 5) and maxilla (Pl. IV., Fig. 6) do not differ noticeably from those of the other species of the genus.

1st Maxillipede (Pl. VI., Fig. 7) with spine on 5th lobe smaller than that on 4th.

2nd Maxillipede (Pl. VI., Fig. 8) with the five terminal joints very short. The form of the sensory lobe on the 1st joint could not be made out; proximal part of upper edge of 2nd joint very finely denticulate.

1st foot (Pl. VI., Fig. 9) with 3-jointed exop., the 1st joint terminating on the outer edge with a small inconspicuous spine.

2nd and 3rd feet (Pl. VI., Figs. 10–11) with no distinguishing features.

4th foot (Pl. VI., Fig. 12), 1st basal joint with a row of lamellae running along inner edge, and curving across lower face of the joint.

5th feet absent.

One specimen was obtained in the townets on the trawl at station Helga CXX.

This species has the upright spine of *G. miles*, and the short antennae and 3-jointed exop. of 1st foot of *G. armiger*, and thus forms a link between the two sections of the genus. It differs from all described species except *G. caudani* in having a spine on the outer edge of the 1st joint of exop. of 1st foot.

Gaetanus minor, n. sp.

(Pl. V., Figs. 1–11).

Length, female, 2·4 mm.

Cephalic spine slender, directed forwards, as in *G. armiger*.

Thoracic segments 4 and 5 fused, with long slender spines reaching to end of genital segment.

Abdomen of 4 segments, short; genital segment slightly swollen ventrally; equal in length to the two following segments.

1st Antenna (Pl. V., Fig. 3) 23-jointed, reaching to end of genital segment; length, 1·7 mm. Length of antennal joints in ·01 mm.:—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
12.	8.	5.	4	5.	5.	6.	8.	5.	5.	6.	8.	8.	10.	10.	11	11.	14.	12.	10.	13.	12.	15.

2nd Antenna (Pl. V., Fig. 4) with rather slender endop., about half as long as the exop.

Mandible and Maxilla (Pl. V., Fig. 5) resemble those of *G. armiger*; the setae on the end of the 2nd inner lobe of the Maxilla are unusually large.

1st Maxillipede (Pl. V., Fig. 6) with one of the setae on 1st lobe a little stronger than those on the succeeding lobes.

2nd Maxillipede (Pl. V., Fig. 7) with 4th and 5th joints equal, the 2nd joint without denticulations.

1st foot (Pl. V., Fig. 8) with 2-jointed exop.; no sign of segmentation in the 1st joint.

2nd foot (Pl. V., Fig. 9) with 1-jointed endop., its 1st outer edge and 2nd inner edge seta being very slender. Terminal spines of the exop. of this, as of the 3rd and 4th feet, very coarsely toothed.

3rd and 4th feet (Pl. V., Figs. 10–11), rather slender, the inner edge of 1st basal joint of both being finely setose.

This species is the smallest of the genus and differs from any previously described in the 1-jointed exop. of 2nd foot, and in the shortness of the 1st antennae.

A female and an immature male, which was not examined in detail, were taken in the mid-water net at Helga CXX. In the bottom net at Porcupine IV. there occurred some very immature specimens, ♂ and ♀, of a Gaetanus, length about 2 mm., which closely resembled the above, with the exception that their 1st antennae reached to the furca. These may possibly prove, when mature specimens are found, to belong to a new species.

Chiridius armatus (Boeck.).

Six males of this species, l=3·5 mm., were found in the townets on trawl at Helga CXX., and one female, l=3·3 mm., in townets on trawl at Helga CXXI.

In company with the above, at Helga CXX., there occurred several specimens, both ♂ and ♀, of a form which agreed very closely in everything but size with *C. armatus*. The length of fully matured specimens of the smaller variety was 2·65 mm. for both sexes.

Chiridius Poppei, Giesbr.

A single specimen, female, $l=2 \cdot 64$ mm., very like *C. armatus* in appearance, but without a rostrum, and having the endop. of 2nd feet one-jointed, seems to be referable to this species. The caudal rami had been broken off, which helps to render the identification uncertain. It was found in the townets on trawl at Helga CXX.

Undeuchaeta major, Giesbr.

One specimen, female, $l=5 \cdot 28$ mm., was found at Helga CXX., in tow-nets on trawl.

Undeuchaeta minor, Giesbr.

One specimen, female, $l=4 \cdot 2$ mm., in tow-nets on trawl at Helga CXX., and another at Helga CXXI.

The size of both this and the preceding species is somewhat greater than that given by Giesbrecht, but in other respects they agree with his description.

Euchirella rostrata (Cls.).

One specimen, female, $l=3 \cdot 5$ mm., occurred in the mid-water net at Station Porcupine V.

Euchaeta tonsa, Giesbr.

Two females were found in townets on trawl at Helga CXX. They measured 4·95 and 5·25 mm. respectively, but agreed fairly well with Giesbrecht's description of the species, in the form of the genital protuberance, the number of setae (9) on the proximal outer lobe of the Maxilla, the length of the terminal antennal joints (24+25=19), and the absence of a tuft of hairs on the last thoracic segment.

Euchirella curticauda, Giesbr.

Three females and an immature male in the townets on trawl at Helga CXX.

Several other specimens of Euchirella, all immature males, also occurred, which could not be determined with certainty.

Euchaeta acuta, Giesbr.

A few were found in the mid-water nets at Porcupine V., and in the townets on trawl at Helga CXXI.

Euchaeta norvegica, Boeck.

Several specimens in mid-water net at Helga CXX. and townets on trawl at Helga CXX. and CXXI.

Immature specimens of Euchaeta, belonging to two or three different species, were found in most of the townettings examined.

Scolecithrix dentata, Giesbr.

Females were found in mid-water nets at Porcupine III. and V. and Helga CXX., and also in townets on trawl at Helga CXX.

Scolecithrix minor, Brady.

Females not uncommon in mid-water nets at Porcupine III. and V. and Helga CXX.

Scolecithrix pygmaea, T. Scott.

One specimen, male, in mid-water net at Porcupine III.

Scolecithrix cristata, Giesbr.

Several females and a few males were found in the townets on trawl at Helga CXX.

Scolecithrix chelifer, I. C. Thomps.

One specimen, a female, from townets on trawl at Helga CXX.

The female of this rather remarkable looking copepod had not been taken previously; only the male having been met with by the describer, the late Mr. I. C. Thompson.*

I could find no trace of 5th feet in my specimen.†

The structure of the appendages of the female seems to be similar to those of the male. I give figures of the rostrum and 1st maxillipede (Pl. VII., Figs. 18–19), the details of which are not quite clear from Thompson's drawing.

Scolecithrix emarginata, n. sp.

(Pl. VII., Figs. 6–17).

Length of ♀, 4·3 mm.

Female.—Body elongate ovate, tapering very slightly anteriorly. 4th thoracic segment partially separated from 5th, the combined segments having an emarginate outline in lateral view, as found in *S. dentata.*

Abdomen short, measuring about $\frac{1}{4}$ of Cephalothorax, 4-segmented, anal segment very short. Genital seg. a little longer than broad. 2nd and 3rd segments slightly broader than long.

Furcal rami almost as wide as long, divergent. The furcal setae were missing in my specimens.

1st Antennae (Pl. VII., Fig. 9) long, rather slender, just reaching beyond the furca. 23-jointed. Length, 4·7 mm.

Length of antennal joints in ·01 mm. :—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
24.	24.	12.	12.	12.	11.	10.	18	12.	14.	16.	24.	25.	25.	25.	25.	25.	25.	25.	23.	24.	28.	31.

2nd Antennae (Pl. VI., Fig. 10) of usual type, the exop. being slightly longer than endop., but with a row of fine curved setae on 1st basal.

Mandible not examined.

Maxilla (Pl. VII., Fig. 11) of usual type in *Scolecithrix*, 1st inner lobe rather longer than the spines it bears.

1st Maxillipede (Pl. VII., Fig. 12) resembles somewhat that in *S. cristata*, the sensory appendages being short and apparently with a small bud-like termination.

2nd Maxillipede (Pl. VII., Fig. 13) without a sensory appendage on 1st joint.

The feet are rather broad with fine spinulation on lower face.

1st foot (Pl. VII., Fig. 14) with terminal spine on outer edge of 1st joint of exop.

2nd foot (Pl. VII., Fig. 15).—Endop. 2nd joint with a proximal trans. row of fine spinules, a median row and a pair of distal spinules somewhat larger. Exop. 2nd joint with trans. distal row of fine spinules; 3rd joint with median and distal curved rows of similar spinules.

3rd foot (Pl. VII., Fig. 16).—Endop., 3rd joint with two trans. rows of moderate spinules; 3rd joint with median row of similar spinules and two large distal ones. Exop. 1st joint with distal trans. row; 2nd joint with two lateral rows on distal half joined by a trans. terminal row; 3rd joint with two lateral rows joined by median and distal transverse rows, all of small spinules. In addition to the spinulation on the lower face there are very minute spinules scattered over the upper face of most of the joints.

The spinulation on the 4th feet is much reduced.

* *Ann. and Mag. N. Hist.*, Ser. 7, Vol. XII.

† A 5th pair of feet have since been found in another specimen. They are 3-jointed, of the *Xanthocalanus* type. The cephalon is separate from the thorax, so the species must be referred to the genus *Xanthocalanus.*

5th feet (Pl. VII., Fig. 17), 2-jointed with inner and terminal spines, the inner spine being about twice as long as the other, as in *S. auropecten.*

One mature and three immature specimens occurred in townets on trawl at Helga CXX.

Scolecithrix ovata, n. sp.

(Pl. VI., figs. 13–18 ; Pl. VII., figs. 1–5).

Length of female, 2·3 mm. Male unknown.

Cephalothorax regularly ovate in dorsal and lateral view ; segments 4 and 5 of thorax joined ; lateral margin slightly emarginate.

Abdomen slender, four segmented, about $\frac{1}{4}$ of Cephalothorax.

1st Antennae (Pl. VI., Fig. 14).—23-jointed, reaching to 2nd segment of abdomen ; $l = 2{\cdot}24$ mm. Length of antennal joints in ·01 mm. :—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
12.	13.	7.	5.	6.	6.	5.	8.	6.	7.	7.	9.	10.	11.	11.	12.	12.	12.	12.	12.	11.	14.	16.

2nd Antennae (Pl. VI., Fig. 15), with exop. about $1\frac{1}{3}$ times endop.

Mandible, with exop. only slightly larger than endop.

Maxilla (Pl. VI., Fig. 16), with 1st inner lobe well developed ; the 2nd outer lobe appears to bear only five setae.

1st Maxillipede (Pl. VI., Fig. 17), with 5th lobe large in proportion to the rest ; its spine is slender and slightly longer than that on the 4th lobe ; sensory appendages rather long and slender.

2nd Maxillipede (Pl. VI., Fig. 18) has no noticeable features.

1st foot (Pl. VII., Fig. 1) with spine on outer edge of 1st joint of exop.

2nd foot (Pl. VII., Fig. 2). Exop. with transv. row of spinules distally on 2nd joint ; 3rd joint with two lateral broken lines of minute spinules ; endop. with two distal. two median, and two proximal spinules, moderately large. on 2nd joint.

3rd foot (Pl. VII., Fig. 3).—Exop. with distal row of small spinules on 2nd joint, and curved transv. median row on 3rd ; endop. with three median and two distal spinules on 2nd joint, and two median and three distal large spinules on 3rd joint.

4th foot (Pl. VII., Fig. 4) with exop. and endop. missing in my specimen. The inner marginal spine of 1st basal is short and placed close to the junction of the 1st and 2nd basal joints.

5th foot (Pl. VII., Fig. 5) consists of a broad ovate lamellar joint arising from a small basal ; it bears a short backward directed spine on its inner margin, and a more distal very short spine also on the inner margin.

This species, of which a single specimen was obtained in townets on trawl at Helga CXX., comes close in many points to *S. dentata*, but differs in the form of the feet and in the proportions of the cephalothorax and abdomen.

Scolecithrix echinata, n. sp.

(Pl. IV., Figs. 15–18 ; Pl. V., Figs. 12–17).

Length of female, 1·92. Male unknown.

Female.—Cephalothorax 1·56 mm. ; abdomen, ·36.

Cephalothorax ovate elongate. Thorac. segs. 4 and 5 fused ; abdomen of four segments ; genital seg. slightly swollen, measuring about $1\frac{1}{2}$ times the following segment ; 2nd and 3rd segments equal, each slightly longer than anal seg.

Furcal rami $1\frac{1}{3}$ times as long as broad.

1st Antennae (Pl. IV., Fig. 17) reach to the middle of last thoracic seg., stout, slightly setose, 22-jointed, $l = 1{\cdot}6$ mm.

Length of antennal joints in ·01 mm. :—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.
17.	16.	6.	4.	4.	4.	4.	11.	4.	4.	5.	6.	6.	7.	8.	8.	7.	7.	7.	7.	8.	12.

2nd Antennae (Pl. IV., Fig. 18) resemble those in *S. cristata*, but the endop. is slightly longer in proportion to the exop.

The mandible was badly mounted before examination, but seems to resemble that of *S. cristata.*

Maxilla (Pl. V., Fig. 12), like that of *S. cristata*; the endop. bears 7 setae, and the 1st inner lobe is proportionately more developed.

1st Maxillipede not well preserved, but approaches that of *S. brevicornis* in the length of the terminal pedicellated appendages, which bear bud-like terminations.

2nd Maxillipede as in *S. cristata*; the basal joint bears a sensory appendage, as in that species.

1st foot (Pl. V., Fig. 13) as in *S. brevicornis*.

2nd to 4th feet, while agreeing in shape with those of *S. brevicornis*, differ considerably in spinulation.

2nd foot (Pl. V., Fig. 14).—2nd joint of endop. with two large proximal and three smaller distal spinules; exop. with distal transverse row of spinules on 2nd joint, and two oblique curved rows of very small spinules on 3rd joint. The distal margin of 2nd joint of exop. also bears on the upper side a row of serrations.

3rd foot (Pl. V., Fig. 15) with exop. spinulated as in 2nd foot, endop. with three large curved spinules on 2nd joint and one small proximal and three larger distal spinules on 3rd joint.

The above spinules are all on the lower face of the joints.

4th foot (Pl. V., Fig. 16).—Exop. without spinules; endop. with four large spinules on lower face of 2nd joint, and a few very minute spinules on 3rd joint. The upper face of the endop. bears on its surface very minute spinules in one longitudinal row on 2nd joint, and in two rows on 3rd joint.

5th feet (Pl. V., Fig. 17) resemble those of *S. cristata* in form, but the inner edge spine does not reach to the end of the terminal one. This species is very closely allied to *S. brevicornis*, but differs in the shorter abdomen, which is contained 4 times in the length of the cephalothorax instead of $2\frac{1}{2}$ times, in the spinulation of the endop. of the swimming feet, which consists of a few large spinules instead of numerous small ones, and in the form and comparative length of spines of 5th pair of feet.

One specimen occurred in the mid-water net at station Porcupine III.

Xanthocalanus borealis, G. O. Sars.

(Pl. VIII., Figs. 14–17.)

Several specimens, females, which are undoubtedly referable to this species, occurred at stations Porcupine IV. and Helga CXX. and CXXI., in all cases in townets on trawl or dredge. The largest of these reached 3·5 mm., and with them specimens of all sizes down to 2·5 mm. occurred, all apparently mature or nearly so. The larger specimens had 5th feet as figured by Sars for *X. borealis*;* the smaller, *i.e.*, from about 3 mm. downwards had 3-jointed 5th feet (Pl. VIII., Fig. 17), with a single terminal and two lateral spines on the last joint. In some instances the segmentation between the 2nd and 3rd joints was very incomplete or absent, thus approaching the immature form figured by Sars. The smaller specimens might, if they were regarded as mature, be referred to *X. fragilis* Aurivillius,† but it seems equally probable that they are specimens of *X. borealis* which have not undergone their final ecdysis at which the second terminal spine and the robust spinulation would probably be acquired. From 2·5 to 2 mm. other specimens occurred, which showed immature jointing of the abdomen, but appeared mature in other respects. These differed from the preceding in that the 5th thorac. seg. was separated from the 4th, and much contracted. The outline of the animal was short and broad, and resembled the figure given by Dr. T. Scott in 20th Report of the Scotch Fishery Board.‡ The 5th feet were the same as in specimens of 2·5 to 3 mm. It is possible that there may be two

* G. O. Sars, *Crustacea of Norway*, Pt. IV., Copepoda, Pl. XXXII,

† Aurivillius, *Konigl. Svenska Akad. Hand.* Band 20, No. 3.

‡ *20th Report of Scotch Fishery Board*, Part IV., Pl.

species included under these various forms, but in default of further information, it seems safer to regard them all as *X. borealis* at various stages of maturity.

The 5th feet of the mature *X. borealis* seem subject to variation both as regards jointing and number of spines. I have figured three of the forms which were met with in the collection. (Pl. VIII., Figs. 14–16.)

Xanthocalanus Greeni, n. sp.

(Pl. VIII., Figs. 1–13).

Length, female, 6·00 mm. Male unknown.

Body (Pl. VIII., Fig. 1) very robust, ovate, opaque. Thorac. seg. 4 and 5 coalesced, slightly produced posteriorly, lateral margins obtuse.

Abdomen very short, anal seg. retracted almost out of sight. Furcal rami broader than long. Furcal setae missing in my specimen.

1st Antennae (Pl. VIII., Fig. 2) stout, very sparingly setose, slightly longer than body, 24-jointed, $l = 6{\cdot}8$ mm. Length of antennal joints in ·01 mm. :—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10	11.	12	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
48.	48.	24.	24.	24.	24.	24.	32.	18.	20.	20.	24.	26.	30	32.	32.	33.	33.	35.	28.	24.	30.	32.	17.

2nd Antenna (Pl. VIII., Fig. 3) with exop. slightly longer than endop. ; 1st joint of endop. comparatively long and slender.

Mandible (Pl. VIII., Fig. 4), cutting edge with numerous weak teeth.

Maxilla (Pl. VIII., Fig. 5) with long and narrow 1st inner lobe, bearing long razor-like spines ; 2nd inner lobe (not shown in figure) lies under third ; endop., small.

1st Maxillipede (Pl. VIII., Fig. 6) with strongly denticulate spine on 4th lobe ; the seta on 5th lobe is longer than the spine and almost as thick.

2nd Maxillipede (Pl. VIII., Fig. 7) short and stout, with one seta on each of the last four joints, strongly developed, and having a laminated edge.

1st to 4th feet (Pl. VIII., Figs. 9–12) jointed as in the genus.

Endop. of 2nd foot with two oblique rows of strong spinules on 2nd joint, one row of spinules on 2nd and 3rd joints of endop. of 3rd foot, and on 2nd joint of endop. of 4th foot.

The terminal spines of exop. of 2nd and 4th feet are broad and curved with finely denticulate lamina.

5th feet very small, 3-jointed, 3rd joint with one terminal and two lateral spines ; margins of 1st and 2nd joints with very minute spinules. The specimen appears to be not quite mature, so that the 5th feet, when fully developed, may be larger and more spinulose.

This form, the largest of the genus, was found, one specimen only, in the townets on the trawl at station Helga CXX. I have called it after the Rev. W. S. Green, the head of the Fisheries Branch.

Xanthocalanus pinguis, n. sp.

(Pl. VIII., Figs. 18–24 ; Pl. IX., Figs. 1–6).

Length of female, 4·5 mm. Male unknown.

Cephalothorax ovate, moderately robust. Thorac. seg. 1 imperfectly separated from cephalon. Thorac. segs. 4 and 5 separated, the latter produced laterally beyond the middle of gen. segment. The lateral processes swollen, ending bluntly, and filled with small oil globules.

Abdomen of four segments, anal seg. very short, caudal rami slightly longer than broad.

1st Antennae (Pl. VIII., Fig. 20) rather short, not reaching beyond Th. 4, moderately setose, decreasing rather abruptly in thickness after 8th joint, 23-jointed, length=3·3 mm.

Length of antenna joints in ·01 mm. :—

1.	2	3.	4.	5.	6.	7.	8	9	10.	11.	12.	13.	14.	15.	16.	17.	18	19.	20	21.	22.	23.
32.	35.	14.	12.	14.	12.	12.	16.	9.	10.	12.	13.	12.	14.	13.	12.	12.	12.	11.	11.	15.	16.	8.

2nd Antenna (Pl. VIII., Fig. 21) with both exop. and endop. rather short and broad.

Mandible (Pl. VIII., Fig. 22) presents no noticeable features.

Maxilla (Pl. VIII., Fig. 23) with elongate and slender exop. and endop.; the distal spines on the 1st inner lobe are longer than the more proximal. 1st and 2nd maxillipedes (Pl. VIII., Fig. 24, Pl. IX., Fig. 1) of the usual type found in the genus.

1st foot (Pl. IX., Fig. 2), typical.

2nd foot (Pl. IX., Fig. 3), 2nd joint of endop. with a proximal row of very long spinules and a distal group of somewhat shorter ones. Endop. of 3rd foot (Pl. IX., Fig. 4) with row of very long spinules on 2nd joint, and curved row of smaller spinules on 3rd joint.

4th foot (Pl. IX., Fig. 5) with a few small distal spinules on 2nd joint of endop. All the feet rather slender, with long finely denticulate terminal spines.

5th feet (Pl. IX., Fig. 6), 3-jointed; 3rd joint with two terminal and two lateral spines, the face of the joint being minutely spinulose; 2nd joint with a few spinules distally on outer margin; 1st joint with inner margin minutely spinulose.

A single specimen was found in townets on trawl at Helga CXX.

Xanthocalanus obtusus, n. sp.

(Pl. IX., Figs. 10–19).

Length of female, 2·4 mm. Male unknown.

Cephalothorax ovate, robust. Cephalon separated from 1st thoracic seg. Segs. 4 and 5 of thorax separated. 5th segment very short, swollen, obtuse. Abdomen short, of four segments; gen. seg. about as broad as long; anal seg., very short; furcal rami, slightly longer than broad.

1st Antennae (Pl. IX., Fig. 12) reach the middle of the genital seg.; 24-jointed; length = 2·22 mm.

Length of antennae joints in ·01 mm. :—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20	21.	22.	23.	24.
14.	16.	8.	7.	7.	7.	7.	12.	6.	7.	8.	10.	9	11.	11.	10.	10.	8.	8.	8	8.	10.	12.	8.

2nd Antennae (Pl. IX., Fig. 13), as in the genus.

Mandible, cutting edge with weak, finely-divided teeth, palp as usual.

Maxilla (Pl. IX., Fig. 14), 1st inner lobe shorter and broader than is usual in the genus.

1st Maxillipede (Pl. IX., Fig. 15) presents no unusual features.

2nd Maxillipede has a short bud-bearing sensory filament on 1st joint.

1st foot (Pl. IX., Fig. 16), as usual in the genus.

2nd foot (Pl. IX., Fig. 17) with 2nd joint of exop. minutely spinulose on lower face; endop., 2nd joint with two curved rows of long spinules on the inner face near the outer edge.

3rd foot (Pl. IX., Fig. 18).—Exop. with inner face of 2nd and 3rd joints minutely spinulose; endop., 2nd and 3rd joints with long spinules near the outer margin; the outer margin of the 2nd joint bears a row of smaller spinules; 1st basal with a distal transverse row of spinule.

4th foot.—Endop. spinulose, as in 3rd, and has in addition minute spinules over the lower face of the joint.

5th foot (Pl. IX., Fig. 19).—Three-jointed, 2nd joint being the largest. 1st joint bears coarse spinules distally on inner margin, 2nd joint with both margins spinulose, 3rd joint with two terminal and two lateral spines, the face of the joint being minutely spinulose. The 2nd to 4th feet are rather short and stout, and have the lamina of the terminal spines coarsely denticulate.

The most noticeable differences between this and the other species of the genus are the short obtuse 5th thorac. seg., and the form of the 5th pair of feet.

Xanthocalanus, sp., ♂.

(Pl. IX., Figs. 7–9; Pl. XI., Fig. 11).

Only two male specimens of Xanthocalanus were met with in the collection, one at Porcupine IV. and one at Helga CXXI. They were both the same species, one measuring 2·27 mm., and the other 2·2 mm., and do not seem identical with any described species of male, though coming very close to *X. agilis* , and to the form described by Dr. T. Scott as *Phaenna zetlandica* ♂.* The 5th feet were 5-jointed on either side, and resembled somewhat those of *Phaenna spinifera* ♂.

1st Antennae 18-jointed on both sides in one specimen; in the other one antenna was 17-jointed; the jointing of the other was not noted. The antennae were longer than the body by about two joints. I have not put a name to this form as it is not clear to me whether it should be referred to one of the above females.

Genus Brachycalanus, n. gen.

This genus is closely allied to Xanthocalanus and differs mainly in shape of the rostrum, which forms a broad truncated plate, and in the extreme shortness of the 1st antennae.

The mouth parts and feet in the female resemble those found in Xanthocalanus, the vermiform sensory filaments being present in the 1st maxillipedes and the spinous armature on the swimming feet. The cephalon and 1st thoracic segment are separated. The form of the body is robust, and the abdomen short, with broad free margins to its segments.

Brachycalanus atlanticus (Wolfenden).

(Pl. X., Figs. 1–14).

Length of female, 2·0—2·5 mm. Male unknown.

Body (Pl. X., Fig. 1-2) robust ovate; Cephalon separated from Th. 1; Th. 4 and Th. 5 separate; the latter somewhat produced laterally with rounded margin.

Rostrum (Pl. X., Fig. 3) short, broad, square-cut in front, probably with filaments at the angles, though these were absent in my specimens.

Abdomen short, 4-segmented; genital seg. equal to the two following; anal seg. very short, almost concealed by the preceding; furcal rami as broad as long; setae missing in my specimens.

1st Antennae (Pl. X., Fig. 4) only reach to beginning of 3rd thor. seg.; very thick at base; 24-jointed; length, 1·45 mm.

Length of antennal joints in ·01 mm.:—

1.	2	3.	4	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19	20.	21.	22.	23.	24.
18.	12.	6.	5.	6.	5.	5.	7.	4.	4.	4.	5.	5.	6.	6.	7.	7.	6.	6.	6.	6.	8.	10.	3.

2nd Antennae (Pl. X., Fig. 5) short, broad; exop. longer than endop.

Mandible (Pl. X., Fig. 6) as in Xanthocalanus; cutting edge not examined.

Maxilla (Pl. X., Fig. 7).—1st inner lobe narrower than in Xanthocalanus; endop. long and slender.

1st Maxillipede (Pl. X., Fig. 8) with strong spine on 5th lobe, that on 4th lobe much weaker; sensory filaments as in Xanthocalanus.

2nd Maxillipede (Pl. X., Fig. 9) has the structure found in Xanthocalanus.

1st foot (Pl. X., Fig. 10), as in Xanthocalanus.

2nd foot (Pl. X., Fig. 11).—Endop. with three spinules on 1st joint; two rows of similar spinules diagonally on 2nd joint. Exop. with three spinules on lower face of 1st joint and three smaller spinules on its outer edge; there is one spinule, probably more, on the inner edge of 2nd joint; terminal spine with coarsely denticulate lamina.

* *20th Report of Scotch Fishery Board*, Part III., p. 453.

3rd foot (Pl. X., Fig. 12).—Endop. 2nd joint with a diagonal row of spinules, and a row of smaller spinules parallel to inner margin; 3rd joint with diagonal and parallel row, as in 2nd joint; two small spinules on inner face of 1st joint of exop.

4th foot (Pl. X., Fig. 13) with outer and inner margins of 1st basip. strongly spinulose; inner edge seta, short; 1st joint of endop. with a few small spinules, 2nd joint with one, probably more, 3rd joint with three spinules distally near the inner margin.

5th feet (Pl. X., Fig. 14), 3-jointed; 3rd joint long, with two terminal and two lateral spines; all the joints densely covered with moderately small spinules.

Three specimens of this species were washed from sand brought up by a townet on the trawl at Helga CXXI. They measured 2·5, 2·0, and 1·52 mm., respectively. The description is taken from the largest specimen, except as regards the 5th pair of feet, which were only found in the smallest specimen, which, while appearing fully developed in other respects, still showed immature segmentation of the abdomen.

[While the above was in the press a description of this species, under the name of *Xanthocalanus atlanticus*, was published by Dr. Wolfenden.* I have accordingly altered the specific name to correspond, while retaining the generic name here given.]

GENUS **Oöthrix**, n. gen.

This genus resembles Xanthocalanus in most respects. It differs, however, in the form of the rostrum, which resembles that found in Brachycalanus, in the 1st maxillipede, in which the two terminal sensory filaments are short and sausage-shaped instead of being longer than the rest, and the spines on the 4th and 5th lobes are slender, and in the absence of spinulation on the under side of the swimming feet. The antennae are 24-jointed and reach nearly to the end of the cephalothorax. The cephalon is separated from the 1st thoracic seg. The 4th and 5th thoracic segments are separate, the latter being produced on either side into a pair of equal sharp spines.

Oöthrix bidentata, n. sp.

(Pl. X., Figs. 15–18; Pl. XI., Figs. 1–10).

Length of female, 3·0 mm.

Cephalon separated from Th. 1; Th. 4 and 5 separated; the latter produced into two sharp spines on either side.

1st Antenna (Pl. X., Fig. 17), 24-jointed, reaching to 5th thorac. seg.; length. 2·3 mm. Length of antennal joints in ·01 mm.:—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	13.	14.	15.	16.	17.	18	19.	20.	21.	22.	23	24.
16.	12.	5.	5.	6.	6.	6.	11.	6.	7.	8.	9.	10.	12.	12.	12.	12.	13.	14.	12.	11.	12.	10,	6.

2nd Antenna (Pl. X., Fig. 18) somewhat shorter than in Xanthocalanus; exop. slightly longer than endop.

Mandible (Pl. XI., Fig. 1).—Palp as in Xanthocalanus; the cutting edge was lost in mounting. In another specimen (Pl. IV., Fig. 2), referred to below, the cutting edge was armed with long semi-articulate spines.

Maxilla (Pl. XI., Fig. 3) as in Xanthocalanus.

1st Maxillipede (Pl. XI., Fig. 4) with long and fragile sensory filaments; the two terminal filaments are short and swollen; spines on 4th and 5th lobes, long and slender.

2nd Maxillipede (Pl. XI., Fig. 5), as in Xanthocalanus.

1st foot (Pl. XI., Fig. 6) of the form found in Xanthocalanus; the 2nd basal bears on its lower face three small spinules at the base of the endop.

* *Jour. Mar. Biol. Assoc.*, N. S. Vol. VII. No. 1, April, 1904, p. 119.

2nd foot (Pl. XI., Fig. 7) with three spinules on 2nd basal, as in 1st foot; terminal spine of exop. longer than 3rd joint; finely denticulate.

3rd foot (Pl. XI., Fig. 8) with short spinule on 1st basal near its inner edge, and three spinules on 2nd basal; the terminal spine of exop. is a little shorter than the 3rd joint.

4th foot imperfect; it lacks the spinules on 2nd basal.

5th foot (Pl. XI., Fig. 9), 3-jointed both sides; third joint long and narrow, setose on the outer margin, with two terminal and two lateral spines; 2nd joint setose on outer margin.

One specimen of the above was found in the sand brought up by a townet on the trawl at Helga CXXI. Its abdomen showed immature jointing, but it seemed to be fully developed in other respects. In the townets on the trawl at Helga CXX., there occurred two immature specimens of what seems to be a closely allied, if not identical, species. They measured 3·35 mm., and appeared to be immature females, though the structure of the 5th pair of feet (Pl. XI., Fig. 10) resembles somewhat that of a ♂. I have referred to them in the explanation of plates as sp. B.

Phaenna spinifera, Cls.

Two specimens occurred; one ♂ in mid-water net at Porcupine V., and one ♀ in townet on trawl at Helga CXX.

CENTROPAGIDAE.

Centropages typicus, Kröyer.

A few specimens were found at stations Porcupine III. and V.

Temora longicornis, Müll.

Occurred once, in mid-water net, at station Helga CXX.

Metridia lucens, Boeck.

Was found in most of the townets at the Porcupine stations; also in mid-water net at Helga CXX., and townets on trawl at Helga CXX. and CXXI.

Metridia venusta, Giesbr.

Five females, measuring 2·8 to 2·9 mm., and one which only reached 2·52 mm., were found in townets on trawl at Helga CXX. They agreed closely with Giesbrecht's description. They might be equally well referred to the unknown female of *M. Normani* if the recorded distribution of the two species were taken into account.

Thompson's record of *M. venusta* ♂ from the North Atlantic* evidently refers to a species of Heterorhabdus, perhaps *H. longicornis.*

Metridia princeps, Giesbr.

One specimen, female, length 7·65 mm., in townets on trawl at Helga CXX.

Pleuromamma robusta (F. Dahl).

Scarce at Porcupine IV. and V., and rather more plentiful at Helga CXX. and CXXI., in townets on trawl.

Lucicutia flavicornis (Cls.).

One specimen, female, in mid-water net at Porcupine III.

* *Ann. and Mag. N. Hist.* Ser. 7 Vol. XII.

Lucicutia curta, n. sp.

(Pl. XII., Figs. 1–7.)

Length of female 2·4 mm. Cephalothorax 1·75 mm. Abdomen ·65 mm. Male unknown.

Body (Pl. XII., Figs. 1–2) robust ovate, slightly tapered anteriorly. Rostrum not visible in dorsal view. Cephalon separated from Th. 1; Th. 4 and 5 fused; lateral margins of 5th seg. rounded.

Abdomen, 4-segmented; genital seg. equal to the two following; strongly swollen ventrally; furcal rami four times as long as broad.

1st Antennae (Pl. XII., Fig. 3) slightly longer than body; 24-jointed, with very small and inconspicuous aethetasks; lengtb, 2·3 mm.

Length of antenna joints in ·01 mm.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15	16.	17.	18.	19.	20.	21.	22.	23.	24
8.	3.	3.	4.	5.	5.	6	6.	6.	7.	7.	10.	11.	12.	14.	15.	16.	17.	14.	13.	13.	13.	14.	7.

2nd Antennae witb no noticeable features.

Mandible.—2nd joint of endop. longer and slenderer than in *L. flavicornis*; cutting edge with four strong teeth, followed by six weaker ones.

Maxilla, as in *L. flavicornis*.

1st Maxillipede resembles that of *L. flavicornis*; on the proximal side of the 1st lobe there are two moderately long setae directed backwards.

2nd Maxillipede, as in *L. flavicornis*.

1st to 4th swimming feet with 3-jointed exop. and endop.

1st foot (Pl. XII., Fig. 4) with short cylindrical process near inner edge of 2nd basal; terminal spine of exop. longer than the 3rd joint.

2nd foot (Pl. XII., Fig. 5) exop., with terminal spine half as long as 3rd joint.

3rd foot (Pl. XII., Fig. 6) resembles 2nd; there is a small papilla on the 3rd joint of exop., situated about the middle of the anterior third of the joint.

4th foot broken in my specimen.

5th foot (Pl. XII., Fig. 7), outer edge spines of exop. longer and slenderer than in *L. flavicornis*. Terminal spine contained $1\frac{1}{3}$ times in 3rd joint. This species seems intermediate between *L. flavicornis* and *L. longicornis*. It differs from the latter in its larger size; stouter body, with shorter abdomen; shorter caudal rami and shorter antennae.

Two specimens were found in the townets on trawl at station Helga CXX.

Lucicutia atlantica (Wolfenden). ?

A single specimen of a female Lucicutia, length 3·5 mm., with long antennae and furcal rami, was found in the townet on the dredge at station Porcupine IV. As it seemed to come very near to *Lucicutia magna* ♂, I forwarded drawings of it to Dr. Wolfenden, who kindly informed me that it seemed to be the same as a female Lucicutia which he had taken in the eastern Atlantic, and which he proposed, in a forthcoming paper, to call *L. atlantica*, though doubtful whether it might not turn out to be the female of *L. magna*.

As my specimen seems to differ from *L. atlantica* in a few small points, I have thought it better to give a few figures. (Pl. XIII., Figs. 5–10.)

Heterorhabdus spinifrons (Cls.).

One specimen, a male, *l.* 3·4 mm., occurred in the townets on the trawl at station Helga CXX. Its length is somewhat greater than that mentioned by Giesbrecht, but it seems to agree in other respects.

Heterorhabdus norvegicus (Boeck.).

A few specimens, both male and female, were found at stations Helga CXX. and CXXI.

Heterorhabdus abyssalis (Giesbr.) ?

Several specimens of a small female Heterorhabdus, *l.* 2·4 mm., were met with at stations Helga CXX. and Porcupine IV., in townets on the dredge or trawl in both instances. They belong to the section of the genus represented by *H. papilliger*, but do not agree with any of the described females. The 1st antennae are longer than the body by about three joints. The innermost of the three terminal spines of the 1st maxillipede is the shortest. The shortest of the three spines of the preceding lobe is more than half the length of the two others. The spine on the end of the inner edge of the 1st joint of the 2nd maxillipede is short and stout, as in *H. papilliger*; the setae on the 2nd joint are as in *H. papilliger*. The setae on the inner edge of 1st and 2nd joints of endop. of 5th foot are very slender, as in *H. clausi*, but the spine on the inner edge of 1st joint of exop., which is found in that species, is absent. It is not possible to be certain of the species until the male has been met with, but the longer 1st antennae and small size seem to indicate that it probably is the female of *H. abyssalis*.

Heterorhabdus vipera (Giesbr.).

Four males, measuring from 3·4 to 3·7 mm., were found in the townets on the trawl at Helga CXX.

Heterorhabdus longicornis (Giesbr.).

Two females of this species, measuring 3·35 and 3·5 mm., were met with in the townets on the trawl at Helga CXX. In the same haul were two males, *l.* 4·15 and 4·2, of the *H. longicornis* type, which, though considerably larger than the females, yet are probably referable to the same species. They agree closely, except in size, with the species described by Dr. Wolfenden as *H. zetesios*,* which, he informs me, he now regards as the male of *H. longicornis*.

It may be, however, that my specimens belong to the imperfectly-described *H. major* of Dahl.

Haloptilus longicornis (Cls.).

One specimen in a bottom townet at station Porcupine V.

Haloptilus acutifrons (Giesbr.).

One rather battered specimen, *l.* 2·64 mm., in townets on the trawl at station Porcupine IV.

An immature and imperfect ♂ *l.* 3·7, with rounded head, which was found in mid-water net at Helga CXX. perhaps belongs to *H. fertilis*.

Phyllopus bidentatus, Brady.

I have included under this name three specimens of Phyllopus—two females and a male. The two females differ in size, form of thoracic segments, and 5th feet, from each other, and from the specimens described by Brady and Giesbrecht. One, *l.* 3·0 mm., has a symmetrical 5th Th. seg., produced into a point on either side, as in the specimen figured by Dr. T. Scott from the Gulf of Guinea.† It also resembles that specimen in its 5th feet, which are short and strong and bear no seta on their 2nd basal joint.

The other, measuring 2·4 mm., has 5th thoracic seg. symmetrical and rounded laterally. The 5th feet are more slender and have an outer edge seta on 2nd basal joint.

* *Journ. Mar. Biol. Assoc.*, N.S. Vol. VI., No. 3 (Jan., 1902), p. 367.
† *Tr. Linn. Soc. Lond.*, Ser. 2, Vol. 6.

The relative proportions of the 1st antennae joints differ slightly in the two specimens, joints 13 and 14 being relatively much shorter in the smaller specimen.

As far as it is possible to judge from the very few specimens which have been figured or recorded, all these different forms seem to belong to one remarkably variable species, a very unusual occurrence amongst the copepoda.

The male of this species has been recorded from the N. Atlantic and in part figured by the late Mr. I. C. Thompson,* but as his figures differ somewhat from mine, I have drawn the appendages in which the male differs from the female. The 1st antenna on the right side is identical in both sexes.

CANDACIIDAE.

Candacia norvegica, Boeck.

Two females were found in the townets on the trawl at station Helga CXX.

PONTELLIDAE.

Acartia Clausi, Giesbr.

Occurred more or less abundantly at all the Porcupine stations and in the mid-water net at Helga CXX. A few specimens which were found in the townets on the trawl at Helga CXXI., may have been taken on the way up.

CYCLOPIDAE.

Oithona similis (Cls.).

Found in most of the nets, both surface and bottom, on the Porcupine stations.

Oithona plumifera (Baird).

Found, like the last, in small or moderate numbers at most of the Porcupine stations.

HARPACTICIDAE.

Microsetella atlantica (Brady and Rob.).

Single specimens occurred twice, at Porcupine III. and V., and may have been overlooked in other instances.

Aegisthus mucronatus (Giesbr.).

One specimen, which seems to belong to this species, length 1·86 mm., caudal seta 9·15 mm., was found in the townets on the dredge at station Porcupine IV.

Aegisthus spinulosus, n. sp.

Pl. XII., Figs. 8–14; Pl. XIII., Figs. 1–4).

Female—*l.* 1·74; length of caudal seta 1·92.

Form of body as in *A. aculeatus*, but segmentation between 1st and 2nd abdominal segments complete, and head without chitinous reticulations. Posterior margin of 2—4 thorac. seg. and 2—5th abd. segs., denticulate.

* *Ann. and Mag. N. Hist.*, Se. 7, Vol. XII.

1st antenna (Pl. XII., Fig. 10), 7-jointed; **a long aesthetask** on 3rd and a shorter one on 7th joint.

Proportional length of joints in ·01 mm.:—

$$\frac{1.\ 2.\ 3.\ 4.\ 5.\ 6.\ 7}{24.\ 26.\ 18.\ 14.\ 3.\ 3.\ 5}.$$

2nd Antenna as in *A. aculeatus*, with long 2nd basal bearing distally a long exop. and proximally a very short endop.

Mandible (Pl. XII., Fig. 11), cutting edge with five teeth and one seta; there is a small 2nd basal and two-jointed exop. present, the latter with two terminal setae.

Maxilla (Pl. XII., Fig. 12) as in *A. aculeatus*.

1st Maxillipede (Pl. XII., Fig. 13) of the same form as in *A. aculeatus*; 1st inner lobe bears five setae; 2nd inner lobe with three setae; 3rd and 4th inner lobes with three setae each; and 5th inner lobe with a larger, regularly-shaped falcate spine.

2nd Maxillipede (Pl. XIII., Fig. 2) resembles that of *A. aculeatus*.

1st feet (Pl. XII., Fig. 14) resemble those of *A. aculeatus*; the spinulations on the surface of the joints seem to be absent.

The segmentation between joints 2 and 3 of the endop. is only faintly indicated.

2nd to 4th feet as in *A. aculeatus*.

5th feet (Pl. XIII., Fig. 3) resemble those of *A. aculeatus*, but seem to differ slightly in the form of the spines.

6th feet with two short equal terminal setae.

This species comes very close to *A. aculeatus*, but differs in the absence of chitinous reticulation, shorter caudal setae, complete division of genital segment, proportional length of 4th joint of 1st antenna, presence of an exop. on mandible, and of two equal setae on 6th foot.

One specimen was found in the townets on the trawl at station Helga CXX.

Idya furcata (Baird).

One specimen was found in the townets on the trawl at Helga CXXI. This species, usually taken in shallow water, has recently been recorded by Dr. T. Scott* from a depth of 87 fath. in the Faroe Channel, and the present record considerably extends its bathymetric range. Not being well acquainted with the genus, I submitted drawings of this specimen to Mr. A. Scott, who agrees with me in thinking that it should be referred to one of the forms of *Idya furcata*.

ONCAEIDAE.

Oncaea conifera, Giesbr.

Occurred in small numbers at most of the Porcupine stations, and in the mid-water net at Helga CXX.

Conaea rapax, Giesbr.

One specimen in bottom townet at Porcupine III.

* *Journal Linn. Soc.*, Vol. XXIX.

EXPLANATION OF PLATES III.-XIII.

The figures were all drawn by means of a *camera lucida.*

PLATE III.

Spinocalanus magnus, Wolfenden.

Fig. 1.	Female,	dorsal view.	
Fig. 2.	,,	lateral view.	
Fig. 3.	,,	1st antenna,	× 39
Fig. 4.	,,	2nd antenna,	× 88
Fig. 5.	,,	mandible palp,	× 75
Fig. 6.	,,	maxilla,	× 138
Fig. 7.	,,	1st maxillipede,	× 138
Fig. 8.	,,	2nd maxillipede,	× 88
Fig. 9.	,,	1st foot,	× 88
Fig. 10.	,,	2nd foot,	× 88
Fig. 11.	,,	3rd foot,	× 88
Fig. 12.	,,	4th foot, basal joint,	× 138

Bradyetes inermis, n. sp.

Fig. 13.	Female,	lateral view.	
Fig. 14.	,,	dorsal view.	
Fig. 15.	,,	1st antenna,	× 58
Fig. 16.	,,	2nd antenna,	× 75
Fig. 17.	,,	maxillae,	× 160
Fig. 18.	,,	2nd maxillipede,	× 58
Fig. 19.	,,	1st foot,	× 116
Fig. 20.	,,	2nd foot,	× 75

PLATE IV.

Bryaxis minor, n. sp.

Fig. 1.	Female,	lateral view,	× 53
Fig. 2.	,,	dorsal view,	× 53
Fig. 3.	,,	1st antenna,	× 98
Fig. 4.	,,	2nd antenna,	× 88
Fig. 5.	,,	2nd antenna, exopodite,	× 245

Bryaxis brevicornis, G. O. Sars.

Fig. 6.	Female,	2nd antenna, exopodite,	× 245

Bryaxis minor, n. sp.

Fig. 7.	Female,	maxilla,	× 245
Fig. 8.	,,	1st maxillipede,	× 245
Fig. 9.	,,	2nd maxillipede,	× 88
Fig. 10.	,,	1st foot,	× 113
Fig. 11.	,,	2nd foot,	× 113
Fig. 12.	,,	3rd foot,	× 113

Bradyetes inermis, n. sp.

Fig. 13.	Female,	3rd foot,	× 75
Fig. 14	,,	4th foot,	× 75

Scolecithrix echinata, n. sp.

Fig. 15.	Female,	lateral view,	× 53
Fig. 16.	,,	dorsal view,	× 53
Fig. 17.	,,	1st antenna,	× 100
Fig. 18.	,,	2nd antenna,	

Plate V.

Gaetanus minor, n. sp.

Fig. 1.—Female,	dorsal view,	× 34
Fig. 2. ,,	lateral view,	× 34
Fig. 3. ,,	1st antenna,	× 58
Fig. 4. ,,	2nd antenna,	× 104
Fig. 5. ,,	maxilla,	× 250
Fig. 6. ,,	1st maxillipede,	× 104
Fig. 7. ,,	2nd maxillipede,	× 84
Fig. 8. ,,	1st foot,	× 84
Fig. 9. ,,	2nd foot,	× 84
Fig. 10. ,,	3rd foot,	× 84
Fig. 11. ,,	4th foot,	× 84

Scolecithrix echinata, n. sp.

Fig. 12.—Female,	maxilla,	× 295
Fig. 13. ,,	1st foot,	× 128
Fig. 14. ,,	2nd foot,	× 128
Fig. 15. ,,	3rd foot,	× 128
Fig. 16. ,,	4th foot,	× 128
Fig. 17. ,,	5th foot,	× 295

Plate VI.

Gaetanus Holti, n. sp.

Fig. 1.—Female,	dorsal view.	
Fig. 2. ,,	lateral view.	
Fig. 3. ,,	1st antenna,	× 28
Fig. 4. ,,	2nd antenna,	× 50
Fig. 5. ,,	mandible cutting edge,	× 104
Fig. 6. ,,	maxilla,	× 67
Fig. 7. ,,	1st maxillipede,	× 67
Fig. 8. ,,	2nd maxillipede,	× 50
Fig. 9. ,,	1st foot,	× 50
Fig. 10. ,,	2nd foot,	× 50
Fig. 11. ,,	3rd foot,	× 50
Fig. 12. ,,	4th foot,	× 50

Scolecithrix ovata, n. sp.

Fig. 13.—Female,	lateral view,	× 34
Fig. 14. ,,	1st antenna,	× 57
Fig. 15. ,,	2nd antenna,	× 92
Fig. 16. ,,	maxilla,	× 260
Fig. 17. ,,	1st maxillipede,	× 260
Fig. 18. ,,	2nd maxillipede,	× 135

Plate VII.

Scolecithrix ovata, n. sp.

Fig. 1.—Female,	1st foot,	× 92
Fig. 2. ,,	2nd foot,	× 92
Fig. 3. ,,	3rd foot,	× 92
Fig. 4. ,,	4th foot, basal joints,	× 88
Fig. 5. ,,	5th foot,	× 260

Scolecithrix emarginata, n. sp.

Fig. 6.—Female,	lateral view,	×	21
Fig. 7.	,, dorsal view,	×	21
Fig. 8.	,, rostrum,	×	58
Fig. 9.	,, 1st antenna,	×	31
Fig. 10.	,, 2nd antenna,	×	58
Fig. 11.	,, maxilla,	×	93
Fig. 12.	,, 1st maxillipede,	×	107
Fig. 13.	,, 2nd maxillipede,	×	209
Fig. 14.	,, 1st foot,	×	58
Fig. 15.	,, 2nd foot,	×	58
Fig. 16.	,, 3rd foot,	×	58
Fig. 17.	,, 5th foot,	×	122

Scolecithrix chelifer, I. C. Thomps.

Fig. 18.—Female,	head,	×	27
Fig. 19.	,, 1st maxillipede, ...	×	43

PLATE VIII.

Xanthocalanus Greeni, n. sp.

Fig. 1.—Female,	dorsal view,	×	14
Fig. 2.	,, 1st antenna,	×	21·5
Fig. 3.	,, 2nd antenna,	×	46
Fig. 4.	,, mandible palp,	×	46
Fig. 5.	,, maxilla,	×	46
Fig. 6.	,, 1st maxillipede,	×	32
Fig. 7.	,, 1st maxillipede, terminal joints,	×	120
Fig. 8.	,, 2nd maxillipede,	×	28
Fig. 9.	,, 1st foot,	×	28
Fig. 10.	,, 2nd foot,	×	28
Fig. 11.	,, 3rd foot,	×	28
Fig. 12.	,, 4th foot,	×	28
Fig. 13.	,, 5th foot,	×	68

Xanthocalanus borealis, G. O. Sars.

Fig. 14.—Female,	5th foot, typical form	×	154
Fig. 15.	,, ,, variety,	×	154
Fig. 16.	,, ,, ,,	×	154
Fig. 17.	,, immature 5th foot,	×	·154

Xanthocalanus pinguis, n. sp.

Fig. 18.—Female,	lateral view.		
Fig. 19.	,, dorsal view.		
Fig. 20.	,, 1st antenna,	×	39
Fig. 21.	,, 2nd antenna,	×	39
Fig. 22.	,, mandible palp,	×	50
Fig. 23.	,, maxilla,	×	68
Fig. 24.	,, 1st maxillipede,	×	68

PLATE IX.

Xanthocalanus pinguis, n. sp.

Fig. 1.—Female,	2nd maxillipede,	×	39
Fig. 2.	,, 1st foot,	×	39
Fig. 3.	,, 2nd foot,	×	39
Fig. 4.	,, 3rd foot,	×	39
Fig. 5.	,, 4th foot, endop. and basal joints,	×	39
Fig. 6.	,, 5th foot,	×	68

Xanthocalanus sp.

Fig. 7.—Male.		
Fig. 8. ,,	5th feet,	× 110
Fig. 9. ,,	terminal joints of left 5th foot.	

Xanthocalanus obtusus, n sp.

Fig. 10.—Female,	lateral view,	× 41·5
Fig. 11. ,,	dorsal view,	
Fig. 12. ,,	1st antenna,	× 70
Fig. 13. ,,	2nd antenna,	× 83
Fig. 14. ,,	maxilla,	× 148
Fig. 15. ,,	1st maxillipede,	× 98
Fig. 16. ,,	1st foot,	× 83
Fig. 17. ,,	2nd foot,	× 83
Fig. 18. ,,	3rd foot,	× 83
Fig. 19. ,,	4th foot,	× 148

PLATE X.

Brachycalanus atlanticus (Wolfenden).

Fig. 1.—Female,	lateral view,	× 40
Fig. 2. ,,	dorsal view,	× 40
Fig. 3. ,,	rostrum,	× 70
Fig. 4. ,,	1st antenna,	× 92
Fig. 5. ,,	2nd antenna,	× 92
Fig. 6. ,,	mandible palp,	× 92
Fig. 7. ,,	maxilla,	× 140
Fig. 8. ,,	1st maxillipede,	× 140
Fig. 9. ,,	2nd maxillipede,	× 92
Fig. 10. ,,	1st foot,	× 92
Fig. 11. ,,	2nd foot,	× 92
Fig. 12. ,,	3rd foot,	× 92
Fig. 13. ,,	4th foot,	× 92
Fig. 14. ,,	5th foot,	× 310

Oöthrix bidentata, n. sp.

Fig. 15.—Female,	lateral view,	× 30
Fig. 16. ,,	rostrum,	× 50
Fig. 17. ,,	1st antenna,	× 50
Fig. 18. ,,	2nd antenna,	× 80

PLATE XI.

Oöthrix bidentata, n. sp.

Fig. 1.—Female,	mandible palp,	× 80
Fig. 2. ,,	sp. B. mandible, cutting edge,	× 290
Fig. 3. ,,	maxilla,	× 142
Fig. 4. ,,	1st maxillipede,	× 142
Fig. 5. ,,	2nd maxillipede,	× 80
Fig. 6. ,,	1st foot,	× 80
Fig. 7. ,,	2nd foot,	× 80
Fig. 8. ,,	3rd foot,	× 80
Fig. 9. ,,	5th foot,	× 142
Fig. 10. ,,	sp. B. 5th foot,	× 106

Xanthocalanus sp.

Fig. 17.	Male, 3rd foot,	× 71

Phyllopus bidentatus, Brady.

Fig. 12.	— Male,	dorsal view,	× 25
Fig. 13.	,,	lateral view,	× 25
Fig. 14.	,,	rostrum.	
Fig. 15.	,,	thoracic segments, lateral view.	
Fig. 16.	,,	1st antenna,	× 68
Fig. 17.	,,	maxilla,	× 134
Fig. 18.	,,	5th foot, left,	× 90
Fig. 19.	,,	5th foot, right,	× 90
Fig. 20.	—Female,	5th foot,	× 134
Fig. 21.	,,	5th foot, another specimen,	× 234

Plate XII.

Lucicutia curta, n. sp.

Fig. 1.	—Female,	dorsal view,	× 38
Fig. 2.	,,	lateral view,	× 38
Fig. 3.	,,	1st antenna,	× 57
Fig. 4.	,,	1st foot,	× 130
Fig. 5.	,,	2nd foot,	× 99
Fig. 6.	,,	3rd foot,	× 99
Fig. 7.	,,	5th foot,	× 130

Aegisthus spinulosus, n. sp.

Fig. 8.	—Female,	dorsal view,	× 48
Fig. 9.	,,	lateral view,	× 48
Fig. 10.	,,	1st antenna,	× 67
Fig. 11.	,,	mandible,	× 305
Fig. 12.	,,	maxilla,	× 305
Fig. 13.	,,	1st maxillipede,	× 305
Fig. 14.	,,	1st foot,	× 116

Plate XIII.

Aegisthus spinulosus, n. sp.

Fig. 1.	—Female,	abdomen ventral,	× 90
Fig. 2.	,,	2nd maxillipede,	× 305
Fig. 3.	,,	end of 5th foot,	× 288
Fig. 4.	,,	caudal seta, median and terminal portions,	× 228

Lucicutia atlantica (Wolfenden)?

Fig. 5.	—Female,	dorsal view,	× 23
Fig. 6.	,,	1st antenna,	× 43
Fig. 7.	,,	abdomen and furca,	× 49
Fig. 8.	,,	2nd antenna,	× 108
Fig. 9.	,,	1st foot,	× 77
Fig. 10.	,,	5th foot,	× 77

REPORT ON THE COPEPODA OF THE ATLANTIC SLOPE OFF COUNTIES MAYO AND GALWAY.

ADDENDUM.

Since the above was printed Professor G. O. Sars has published the first instalment of a preliminary list of Copepoda Calanoida taken during the "Campaigns" of the Prince of Monaco,* with descriptions of very many new species.

Some of these are undoubtedly identical with species described in the above paper, and the names given therein will have to be withdrawn.

Gaetanus latifrons, G. O. Sars, is plainly the same as *G. Holti*, described above, the shape of the body, the strong cephalic spine, and the elongate spines on the last thoracic segment, together with the spine on the outer edge of the 1st joint of the three-jointed exopod of the 1st foot distinctly separating it from all other members of the genus.

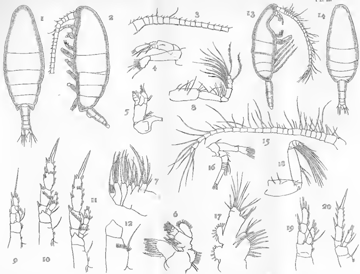
I have little doubt that *Xanthocalanus Greeni* should be relegated to the synonomy of *X. muticus*, G. O. Sars, but, as the latter species is said to have the 5th pair of feet two-jointed while in the specimen of *X. Greeni* examined by me they were three-jointed, it may perhaps be as well to reserve judgment until figures of *X. muticus* have been published.

Onchocalanus trigoniceps, G. O. Sars, is apparently identical with the species referred to above under the name of *Xanthocalanus chelifer* (I. C. Thompson). If, as seems probable, the male described by Thompson should prove undoubtedly to belong to the same species as the female here referred to, the name given by Thompson will have to stand.

The species which I have described as *Scolecithrix emarginata* seems to agree in size and general appearance with *S. gracilis*, G. O. Sars, but, as far as can be gathered from Sars' somewhat inadequate description, points of difference are to be found in the form of the last thoracic segments and of the 5th feet.

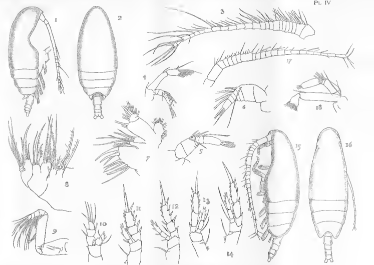
G P. Farran.

* *Bull. Mus. Oceanograph. Monaco.* No. 26. 20 March, 1905.



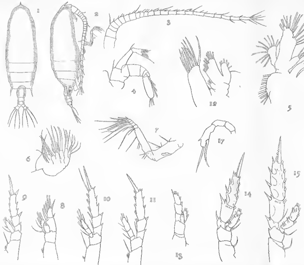
G. P. Farran
A. B. Woodward } del.

1–12. Spinocalanus magnus   13–20. Bradyetes inermis



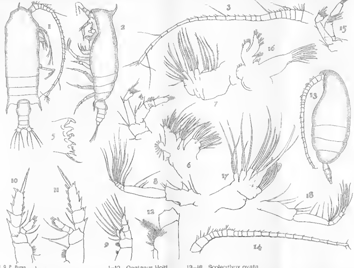
G. P. Farran } del.
A. H. Woodward }

1–5, 7–12. Bryaxis minor. 6. Bryaxis brevicornis. 13, 14. Bradyetes inermis.
15–18. Scolecithrix echinata.



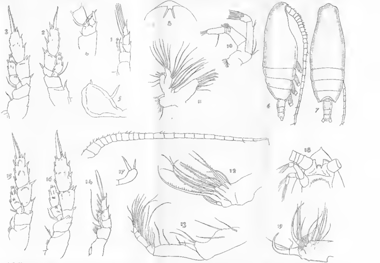
G. P. Farran } del.
A. H. Woodward } del.

1–11 Gaetanus minor 12–17 Scolecithrix echinata



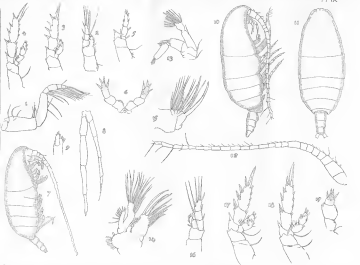
G. P. Farran / A. B. Woodward del.

1–12 Gaetanus Holti. 13–18 Scolecithrix ovata



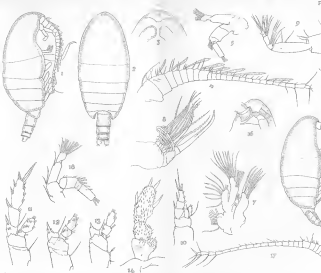
A. B Wor-hward
C. F Farran } del

1-5 Scolecithrix ovata   6&7 Scolecithrix emarginata   18-19 Scolecithrix chelifer



C F Fowan
A E Woodward } del

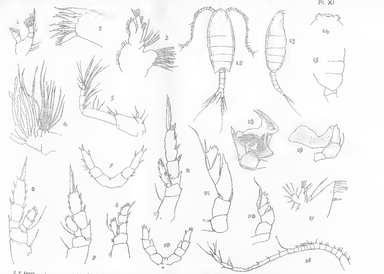
1-6 Xanthocalanus pinguis 7-9 Xanthocalanus sp 10-19 Xanthocalanus obtusus



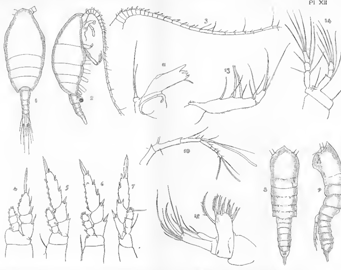
C. F. Farran
A. B. Woodward } del

1–14 Brachycalanus atlanticus

15–18 Oöthrix bidentata



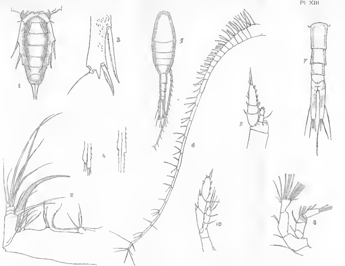
1–10. Oöthrix bidentata. 11. Xanthocalanus sp. 12–21. Phyllopus bidentatus.



G P Farran del.

1-7 *Lucicutia curta*

8-14 *Aegisthus spinulosus*



G P Farran
A B Woodward } del

1-4 Aegisthus spinulosus.

5-10 Lucicutia atlantica.

APPENDIX, No. III.

THE MARINE FAUNA OF THE WEST COAST OF IRELAND.

PART II.

i.—The Molluscs and Brachiopods of Ballynakill and Bofin Harbours, Co. Galway, and of the Deep Water off the West and South-West Coasts of Ireland, by E. R. SYKES, B.A.

ii.—On specimens of *Tracheloteuthis* and *Cirroteuthis* from Deep Water off the West Coast of Irel: ·d, by W. E. HOYLE.

—THE MOLLUSCS AND BRACHIOPODS OF BALLYNAKILL AND BOFIN HARBOURS, CO. GALWAY, AND OF THE DEEP WATER OFF THE WEST AND SOUTH-WEST COASTS OF IRELAND.

BY

E. R. SYKES, B.A.

PLATE XIV., FIG. 6,
and Charts of Ballynakill and Bofin Harbours.

INTRODUCTORY.

The molluscs collected at the Marine Laboratory and by the steam cruiser "Helga" were to have been described by the late Mr. M. F. Woodward. After his lamented death in September, 1901, I was asked to complete the account. All the specimens which it had been considered necessary to preserve were placed in my hands, together with Mr. Woodward's notes, and the records of the more familiar forms kept by the naturalists of the Fisheries Branch of the Department. The nomenclature and arrangement are adopted from the most recent list of the British fauna, while the details of distribution, given under each species, have been compiled by Mr. Holt, who has brought the records up to the end of 1902, and is responsible for their accuracy. In the case of some forms, which had been almost certainly neglected or confused in the records, Mr. W. M. Tattersall has made special collections in 1903 and 1904, and the results are here incorporated, together with any noteworthy record made during the same period. For the convenience of those to whom Jeffreys' well known "British Conchology" is familiar, the names used by him are given as synonyms, where they differ from those now employed. Mr. Woodward had made a number of drawings, relating chiefly to the anatomy of the *Rissoidae*, but, unfortunately, they are in many cases not labelled with the specific name, well known, no

doubt, to him. Indeed the only sketch that I have felt it safe to reproduce is a pencil one dealing with *Ianthina*. The paper falls, naturally, into two parts—firstly, that dealing with the shore and shallow water forms collected from the stations at Ballynakill and Bofin; and, secondly, the portion listing the deeper water molluscs obtained by the "Helga."

The present paper must not be taken as giving in any way a full account of the smaller forms, these not having been specially searched for.

No very striking records occur amongst the shallow water forms, but the "Helga" cruises resulted in the obtaining—in addition to the interesting Cephalopods dealt with by Mr. Hoyle—a number of the scarcer forms, such as *Tritonofusus fusiformis* (alive), *Cassidaria*, and broken specimens of *Neptunea despecta*.

The Nudibranchs have already been listed by Mr. Farran (Rep. for 1901, Part II., p. 123*), and the Pteropod records and specimens which have been submitted to me are avowedly very incomplete, a very large number of townet gatherings remaining to be tabulated before this group can be dealt with.

It should be explained that the Marine Laboratory was stationed at Ballynakill and Bofin, respectively, for the periods enumerated below.

Ballynakill.—February, 1899, to May, 1899.
Bofin.—May, 1899, to September, 1899.
Ballynakill.—September, 1899, to May, 1900.
Bofin.—May, 1900, to October, 1900.
Ballynakill.—October, 1900, to April, 1904.

There are, consequently, no winter records from Bofin, and continuous record throughout the year at Ballynakill is confined to 1901 and 1902, though this harbour was visited, from Bofin, at the August spring tides of 1899 and 1900.

The Laboratory records, up to September, 1901, were verified or corrected (by the examination of preserved material) by Mr. Woodward, or by myself in the case of specimens which he had reserved for further consideration. The later records are almost entirely the result of Mr. Farran's observations.

The general characters of Ballynakill Harbour have been noted by Mr. Farran in his report on the Nudibranchs. His chart is reproduced, with some additions, at the end of this paper, and a chart of Bofin Harbour and entrance is also printed.

The following geographical notes are due to Mr. Holt:—

Bofin Harbour is really limited to the area which lies to the east of a line drawn from the castle, on Port Island, north to the opposite shore; but in the records which follow account is also taken of dredgings in the approach to the Harbour and south-west from the Gun Rock as far as the 20 fathom line, or thereabouts. All this outer ground appears to be of much the same character, viz., fine gravel with a great quantity of broken shells, with rocks here and there. The clean nature of the gravel and shells, and the practical absence of weed, alive or drift, appear to afford evidence of constant scouring by tide and storm, but the tide is not by any means violent. The group of rocks and reefs west of Port Island, which form a partial barrier at low water, is too much exposed to furnish good collecting ground. North of them the bottom is mostly rocky, and the north shore, generally as far east as the post office, consists of bare rocks, boulders, and coarse gravel, with an outcrop of peat near low water mark at the pound.

The Harbour proper is divided by Glasillaun into an outer and inner part, which communicate at low water only by narrow guts, on either side of the island, a few inches deep. On the north shore of the Outer Harbour a ridge of gravel, clad with bootlace weed (*Chorda filum*), forms some sort of shelter, but in southerly gales so much swell is deflected up the Harbour that no part of the north shore is of much account for collecting.

* Vide also *infra*, p. 207.

The central part of the Outer Harbour consists of firm sand, which extends some way west of the castle before the bottom becomes rough, but this west part is, in summer, usually so littered with drift weed that it cannot be satisfactorily trawled or dredged. In the east part a Zostera bed extends from Dooneen right across the Harbour and along the south shore almost to the Pool, or anchorage, the bottom of which is fine, rather muddy, sand, with some patches of bright coarse sand towards low-water mark. The little East Bay has a bottom of soft clean sand between tide marks. Port Island Bay between tide marks has a firm sandy bottom, except at the embouchure of the channel, where there is a considerable extent of very soft sand, not extending to low-water mark. The channel is only navigable even by small boats at high-water springs, and is dry, save for a pool in the narrowest part, with a bottom of smooth stones and shingle, at low-water of all tides. West of Port Island Bay the Harbour shore of the island is rocky, and there are the remains of a lobster pond constructed long ago by building a dry stone wall across a shallow indentation. This, and a little hollow to the west of it, covered between tide marks with stones and boulders, form a good collecting ground.

The outer face of Glasillaun is similar, and the southern gut, which is littered with stones, is also good ground.

Immediately outside it is a small rocky pool with a fathom or more of water at low tide. The Inner Harbour is muddy sand, and in places soft mud, with muddy gravel on most of the shore, except where, on the south-east side, the shores are sheer cliffs.

There is a trickle of fresh water entering the Inner Harbour at the north-east corner, and fresh water can be got by digging at several places under the north shore of the Outer Harbour, but the salinity of the Harbour generally does not differ from that of the open sea.

Apart from the Harbour and approaches, mention is made of a few other collecting grounds, viz., the "White Strand," a small steep beach under the cliffs on the west side of the island opposite Inisshark, of no account except for drift material; Knock Beach, a large sandy flat between the island and Inislyon, on the east side; and Davillaun Sound, between Davillaun and Inislyon, 12 to 15 fath., with a bottom of sand and coarse sand, in places rough.

THE MOLLUSCS OF BALLYNAKILL AND BOFIN HARBOURS.

AMPHINEURA.

CHITONIDAE.

Lepidopleurus cancellatus (Sby.).

[**Chiton cancellatus** (Jeffreys).]

Ballynakill Harbour.—Dredged in the channel off the Dawros Crumpaun, and in Fahy Bay.

Bofin Harbour.—Dredged at the mouth of the harbour.

In regard to this and other *Chitonidae*, the laboratory records probably give only an imperfect account, since, though Chitons are constantly taken, they have comparatively seldom been determined or preserved.

Callochiton laevis (Mont.).

[**Chiton laevis** (Jeffreys).]

Ballynakill Harbour.—On the N. shore of Fahy Bay, between tide-marks, and on the Lithothamnion* ground. In the channel off Ross and Fahy Bay.

Craspedochilus cinereus (L.).

[**Chiton marginatus** (Jeffreys).]

Ballynakill Harbour.—A single record from the channel off Fahy Bay. Common on the shores of Fahy.

Bofin Harbour.—On 20th September, 1900, a large quantity were collected around and in the pool near high-water mark in Port Island passage. The species is referred to in the laboratory records as *Ch. marmoratus*, but it is, I think, a slip of the pen for this species.

Craspedochilus asellus.

Ballynakill Harbour.—Five from Coastguard Deep; three from channel off Fahy.

Acanthochites fascicularis (L.).

[**Chiton fascicularis** (Jeffreys).]

Ballynakill Harbour.—A single record from the N. shore of Fahy Bay, between tide-marks, and two from the channel off Ross and off Fahy Bay. One from a hulk moored in Fahy Bay in winter, but in the summer in Blacksod Bay. Also taken 1 mi. S.E. of Lyon Head, Bofin.

In some rough notes of Mr. Woodward's, several other names also occur, but I have not seen the species in the material, and they need confirmation.

PELECYPODA.

NUCULIDAE.

Nucula nucleus (L.).

Ballynakill Harbour.—Generally distributed in the channel of both outer and inner parts of the harbour. Apparently most abundant in the muddy sand of Freaghillaun Deep and of the mouth of Derryinver Bay, and in the deep part of the channel off Fahy Bay, where the bottom is stones, worn shells, Lithothamnion fragments, and rather muddy sand. Specimens have also been taken in the Lithothamnion ground of Fahy Bay. There is no record from Coastguard Deep, though the species occurs between the Deep and the sandbank of the Bay.

Bofin Harbour.—Once recorded from between tide-marks S. of the anchorage pool.

Nucula nitida (G. B. Sowerby).

Ballynakill Harbour.—Taken once between Freaghillaun and Ship Rock.

* The prevailing species is a dendritic form, probably *L. thapsus*.

ANOMIIDAE.

Anomia ephippium (L.).

Ballynakill Harbour.—Attains a very large size on the Lithothamnion ground.

ARCIDAE.

Glycymeris glycymeris (L.).

[Pectunculus glycimeris (Jeffreys).]

Bofin Harbour.—One young and several shells off the mouth of the harbour at 15 fath. Adults and young abundant on the trawling ground between Davillaun and Inislyon.

Arca tetragona (Poli.)

Ballynakill Harbour.—A few living examples recorded from the Lithothamnion ground of Fahy Bay, and from crevices in the Black Rocks.

Bofin Harbour.—A single living example in the outer harbour. A few shells off the Entrance, 15 to 16 fath.

MYTILIDAE.

Mytilus edulis (L.).

Ballynakill Harbour.—Common on the hulks moored in Fahy Bay, and present in insignificant quantity between tide-marks. Not recorded from other parts of the harbour.

Bofin Harbour.—Stunted examples abundant on the rocks at the mouth of the harbour. Broken shells form the largest item of the shell detritus at the Entrance, 15 to 16 fath.

Mytilus modiolus (L.).

Ballynakill Harbour.—Abundant on Fahy Bar towards the S. end, uncovered at very low springs. Also found in the channel outside the Bar, and on the Lithothamnion ground in the N.E. part of Fahy Bay.

Bofin Harbour.—A single young example recorded as dredged at the Entrance, 15 to 16 fath. (? *V. phaseolina*).

Volsella adriatica (Lamarck).

[Mytilus adriaticus (Jeffreys).]

Bofin Harbour.—Valves probably referable to this species twice dredged at the Entrance.

Modiolus barbatus (L.).

[Mytilus barbatus (Jeffreys).]

Ballynakill Harbour.—Fairly common at about 2 fath. in Roeillaun Bay on a bottom of muddy sand, shells and Lithothamnion, with a good deal of weed, but local, since it was not found in most of the hauls in this bay. Elsewhere in the harbour it seems to be rare, and only one shell has been recorded from the channel. A few, living, have been taken on the Ross shore of Fahy Bay, between tide-marks, and, below, on the Lithothamnion ground.

Judging from the frequency of its occurrence on the E. coast of Ireland, it would not seem to be a harbour species.

Bofin Harbour.—Several small recent valves are recorded from the Entrance, 15 to 16 fath.

Modiolaria marmorata (Forbes).

BALLYNAKILL HARBOUR.—Between tide-marks on the N. shore of Fahy Bay; on the Black Rocks attached by byssus to Fucus; in Derryinver Bay in the tests of *Ascidiella aspersa*.

Modiolaria costulata (Risso.).

BALLYNAKILL HARBOUR.—A young specimen from Coastguard Deep.
BOFIN HARBOUR.—One record.

OSTREIDAE.

Ostrea edulis (L.).

BALLYNAKILL HARBOUR.—In so much of the harbour as lies to the S. of a line from Coastguard Bay to Derryinver Quay there were formerly a number of oyster fisheries of considerable importance. There are now only two private fisheries, and the public fishery is of little importance. The part of the harbour most productive as a natural ground is now, and probably has always been, that to the S. of Dawrosbeg, but a certain number of wild oysters are also found around the shores of Fahy Bay, and on the bar, and generally throughout the inner part of the harbour on suitable ground. When the industry was active it is known that numbers of oysters were imported from outside sources, so that the parentage of the present native stock must be rather mixed; and during the period covered by this report a considerable number from Clarenbridge, Crushua, Tralee and Ballyvaldon in Ireland, from Falmouth, the Crouch, Blackwater and Colne in England, and from Auray and Arcachon in France, have been laid in Fahy Bay for observation by the staff of the laboratory. That the product, if any, of these importations will be recognisable from the native stock by conchological characters is more than doubtful, but the fact appears worthy of record.

It may also here be noted that among the consignments from the Essex estuaries were found a number of specimens of *Crepidula fornicata*, a mollusc not indigenous to British waters. It appears to have been introduced to English waters in consignments of American oysters, and to have become thoroughly acclimatised. Should it hereafter appear in Ballynakill Harbour its presence will be accounted for by this note.

BOFIN HARBOUR.—Shells found in the inner harbour appear to be traceable to a laying known to have been made there within the last eighteen years. No living oysters were found.

PECTINIDAE.

Pecten maximus (L.).

BALLYNAKILL HARBOUR.—The shells form a considerable proportion of the bottom deposits of the channel off Fahy Bay and Ross, and living examples are dredged there throughout the year in small numbers. On and outside Fahy Bar in spring and summer the species is sufficiently abundant to attract the occasional attention of local fishermen, who take them with hand nets on calm days at low strands, but the catch never appears to amount to much, and is perhaps pursued more for sport than for profit.

Specimens have been taken in the outer part of the harbour on the shore W. of the old coastguard station, and, in the dredge, between the Green Rocks and Lettermore. Probably in the course of the year the species is pretty generally distributed throughout the harbour, but our records give no certain indications of its migrations.

There seems reason to believe, from enquiries that have reached us from the trade, that Escallops are becoming generally scarce on the W. coast of Ireland.

BOFIN HARBOUR.—Occasionally taken at various points along the S. shore of the inner harbour. Said to occur in some numbers in the inner harbour in summer, but not observed there by us. Two young examples were taken on the trawling ground between Inislyon and Davillaun.

Pecten (Hinnites) pusio (L.).

Ballynakill Harbour.—Although seldom figuring in the records, this species is not infrequent in the channel off Fahy and Ross, and has been taken on the Black Rocks; but it is noticeably much less abundant than on the oyster grounds off the open coasts of counties Wicklow and Wexford. Our knowledge of the western grounds, outside the harbours dealt with in this paper, is, however, insufficient to establish a difference of abundance in relation to geographical distribution, as apart from conditions of environment.

Bofin Harbour.—Represented by shells in the shell deposit at the Entrance. Shells were also found on the trawling ground between Bofin and Davillaun.

Pecten (Chlamys) varius (L.).

Ballynakill Harbour.—Exceedingly common at and below low-water on the Lithothamnion ground and on the bar of Fahy Bay. Much less common on the S. shore of the bay. Common along the shore from Ross Point to Fahy Bay, and observed also between tide-marks on Roeillaun and the Black Rocks. Common in the channel off Ross and Fahy Bay. Apparently absent from the outer part of the harbour.

Bofin Harbour.—Found at low-water between the inner harbour and the anchorage pool. Not abundant.

Pecten (Aequipecten) opercularis (L.).

Ballynakill Harbour.—Constantly taken, but never in large numbers, in the channel off Fahy Bay and Ross as far as coastguard deep. Occurs occasionally between tide-marks in the same region, and is recorded once from the Lithothamnion ground of Fahy Bay. An unusually large specimen is noted from the shore of Coastguard Bay.

Though commoner in the harbour than the Escallop, the Queen is nowhere really abundant. It is essentially an open sea species, affecting coarse sand in rather deep water; and it is probable that the harbour stock is derived, by the immigration of the pelagic young, from a bed near Davillaun, where the species was found in number during the Royal Dublin Society's survey in 1890 and 1891.

Bofin Harbour.—Only represented in our records by young examples, with byssus, taken in the anchorage pool in September. The variety *lineata*, as well as the typical form, were taken in Davillaun Sound.

Pecten (Palliolum) tigerinus (Müller).

Ballynakill Harbour.—Two valves dredged in Coastguard Deep.

LUCINIDAE.

Lucina borealis (L.).

Ballynakill Harbour.—Obtained by digging in the fine sand of Coastguard Bay near low-water mark, about 8 inches below the surface. No mark was observed at the surface of the sand. Dead shells found on the sand at the same place, and dredged in the channel.

Bofin Harbour.—Living examples found in the sand uncovered at exceptional tides between the anchorage pool and the inner harbour. Also found in the sand of the beach between Rusheen and Inislyon. Dead shells on the Rusheen beach.

. . . .

It appears that *L. borealis* has in this region a distinct predilection for sand of rather fine texture. It was not obtained by digging in the coarse shell and Lithothamnion sand of Fahy bar, where *Artemis exoleta* is abundant, nor was its presence observed in Port Island Bay in company with the last-named.

Lucina spinifera (Mont.).

Ballynakill Harbour.—A shell from Freaghillaun Deep.—*Fide* G. P. Farran.

Cryptodon flexuosus (Mont.).

[Axinus flexuosus (Jeffreys).]

Ballynakill Harbour.—Living examples taken on one occasion only on the soft muddy sand of Freaghillaun Deep, the soundings of which are about 8 to 12 fath., low-water. Shells have been taken on fine sand, $2\frac{1}{2}$ to 5 fath., between the Deep and Letter; and, in abundance, between the Deep and the Green Rocks (about 8 fath.), and to the E. of the sand-bank of Coastguard Bay, 3 to 4 fath. The evidence appears to suggest that the species may be one of the numerous molluscs of the distribution of which it is very difficult to take cognisance by ordinary methods of dredging.

Diplodonta rotundata (Mont.).

Bofin Harbour.—A few shells dredged at the Entrance in 15 to 16 fath.

LEPTONIDAE.

Kellia suborbicularis (Mont.).

Ballynakill Harbour.—Fairly abundant in the channel off Fahy Bay and Ross in Lamellibranch shells filled with fine mud, but absent from many such shells, and apparently least common in the deepest part of the ground. Mr. Farran found two in a mass of Lithothamnion dredged in the northern passage of Fahy Bar. At Plymouth, Mr. Holt has found it in mud between stones impacted in a crevice of rock, but could find none in a very similar situation outside the lobster pond at Bofin.

SCROBICULARIIDAE.

Syndosmya alba (Wood).

[Scrobicularia alba (Jeffreys).]

Recorded with a query from dark muddy sand in Derryinver Bay, Ballynakill.

Syndosmya nitida (Müll.).

[Scrobicularia nitida (Jeffreys).]

Ballynakill Harbour.—Apparently almost confined to Derryinver Bay, 3 to 4 fath., muddy sand. A single specimen dredged on the muddy bank off Coastguard Point.

TELLINIDAE.

Tellina crassa (Gmel.).

Bofin Harbour.—A single specimen taken at low water, spring tide, in Port Island Bay.

Tellina squalida (Pult.)

[Tellina incarnata (Jeffreys).]

Ballynakill Harbour.—At low water in Coastguard Bay; apparently not abundant.

Macoma balthica (L.).

[Tellina balthica (Jeffreys).]

BOFIN HARBOUR.—Found only in the inner harbour, on the muddy flat on the S. side; apparently not abundant.

MACTRIDAE.

Spisula solida (L.).

[Mactra solida (Jeffreys).]

BALLYNAKILL HARBOUR.—The only record is from a station (shore-collecting) embracing the whole of the inner part of the harbour, except Derryinver and Barnaderg Bays and the Moyard Creek, on 21st and 22nd August, 1899. Probabilities point to the strand of Coastguard Bay as the site of capture.

Spisula subtruncata (Da Costa).

[Mactra subtruncata (Jeffreys).]

BALLYNAKILL HARBOUR.—Common between tide-marks on the firm sand of Coastguard Bay; observed also on similar, but rather more muddy, ground at the head of Fahy Bay; on the muddy gravel of Rossdhu and of the S. shore of the Bay towards Knocknahaw; and on the clean sandy gravel of the E. shore of Ross. Occurs also in Coastguard Deep (muddy gravel and shells, 6 to 8 fath.), and at the mouth of Derryinver Bay (muddy sand, 3 to 4 fath.).

Though firm sandy ground appears, within the harbour, to be its most congenial haunt, the fact that it is often found at the surface of the sand would seem to indicate that its habitat must be largely influenced by wave action.

Spisula elliptica (Brown).

[Mactra elliptica (Jeffreys).]

BOFIN HARBOUR.—Common at the entrance, on the broken shell ground, 15 to 20 fath. Occurs also commonly in Davillaun Sound.

Lutraria elliptica (Lam.).

BALLYNAKILL HARBOUR.—Common at extreme low water at Coastguard Bay, buried about 8 inches in the sand, the position being indicated by a large round hole at the surface. Shells observed at the head of Fahy Bay, and common in the channel. The species is probably generally distributed in suitable ground throughout the harbour.

BOFIN HARBOUR.—In the sandy bay to the south of the anchorage pool of the outer harbour. Two examples, about an inch in length, with white shells, dredged in the sound between Inislyon and Davillaun, shells and gravel, about 12 fath.

VENERIDAE.

Lucinopsis undata (Pennant).

BALLYNAKILL HARBOUR.—On the strand at the head of Fahy Bay. Recent shells in Coastguard Deep, and off the Ship Rock.

Dosinia exoleta (L.).

[Venus exoleta (Jeffreys).]

[Artemis exoleta (Forbes and Hanley).]

BALLYNAKILL HARBOUR.—Very abundant in a blackish layer about six inches below the surface of the Knocknahaw Bank, near low-water mark of spring tides. The bank consists of coarse Lithothamnion sand. Shells occur on the strand at the head of Fahy Bay and in the channel, and N. entrance.

BOFIN HARBOUR.—Common between tide-marks in the sandy part of the outer harbour. Young examples and dead shells of adults occur on the shell ground at the Entrance, 15 to 20 fath.

Venus (Clausinella) fasciata (Da Costa).

BOFIN HARBOUR.—Once recorded between tide-marks on the shore of Port Island. Fairly common at the entrance, 15 to 20 fath., and in Davillaun Sound.

Venus (Ventricula) casina (L.).

BALLYNAKILL HARBOUR.—Shells in the channel and on Knocknahaw Bank.

BOFIN HARBOUR.—Shells at the Entrance, 15 to 17 fath. (and (?) a living specimen from the same place).

Venus (Ventricula) verrucosa (L.).

BALLYNAKILL HARBOUR.—Recent shells are common on the Knocknahaw Bank; coarse Lithothamnion sand.

Venus (Timoclea) ovata (Pennant).

BALLYNAKILL HARBOUR.—Shells in the Channel and at mouth of Derryinver Bay.

BOFIN HARBOUR.—Can hardly be included in the harbour list. Occurs living off the Entrance at 17 fath., and in Davillaun Sound.

Venus (Chamelaea) gallina (L.).

[Venus striatula (Forbes and Hanley).]

BALLYNAKILL HARBOUR.—Common in the sand of Coastguard Bay at extreme low-water mark. Occurs in a similar situation at the head of Fahy Bay. Young examples were found on one occasion at Coastguard Bay in sand inside the shells of Tapes (probably *T. decussata*). Shells occur in Coastguard Deep.

BOFIN HARBOUR.—Occurs in the anchorage pool of the outer harbour.

Tapes aureus (Gmel.).

BALLYNAKILL HARBOUR.—Common near low-water mark on all parts of the shore of Fahy Bay, and from thence to Coastguard Bay. A few have been taken in Roeillaun Bay.

Tapes virgineus (L.).

Ballynakill Harbour.—Known only from shells, which are common along the shore of Ross between Ross Point and Coastguard Bay, and in the channel. Though one of the commonest shells on British and Irish coasts, it is seldom seen in the living condition. It probably burrows in strong ground, into which the dredge will not bite, and in which, when between tide-marks, digging is difficult.

Tapes pullastra (Mont.).

Ballynakill Harbour.—Between tide-marks in Fahy Bay (except in the sandy strand at the head), on Knocknahaw bank, and on the E. shore of Ross. In Roeillaun Bay at about 2 fath. Shells in the channel off Ross and Fahy Bay.

Bofin Harbour.—Recent shells in the cove between the lobster pond and the castle.

Tapes decussatus (L.).

Ballynakill Harbour.—Common on the E. shore of Ross; also observed at Rossdhu, and probably generally distributed on the muddy or sand gravel of foreshores in other parts of the harbour, though not recorded. Shells in the channel and on the sandy strand at the head of Fahy Bay.

Bofin Harbour.—Occurs in both outer and inner harbour; apparently not in abundance.

. . . .

T. decussatus seems to have no value in this district. In the S.W. of England, as the "Queen Cockle," it appears to be worth gathering, and in France, as "l'Eclovisse," it commands a ready sale.

CARDIIDAE.

Cardium edule (L.)

Ballynakill Harbour.—Cockles are generally distributed, in suitable localities, on the foreshores, but are nowhere of very fine quality or of sufficient abundance to form an important bed. They are little, if at all, collected for food or market.

Bofin Harbour.—Generally distributed on the foreshore of the harbour and on the Rusheen beach. Occasionally collected for sale from the inner harbour. Very fine examples occur on the sandy shores of the outer harbour, but not in large number.

Cardium exiguum (Gmelin).

Ballynakill Harbour.—In the inner part of the harbour it is recorded constantly from the channel off Fahy Bay and Ross as far as Coastguard Bay, and from Roeillaun Bay. It extends also into Fahy Bay on the Lithothamnion ground. Seawards it is recorded only from the Black Rocks, between tide-marks, and from the north channel, N. of the Green Rocks. In the central, muddy, part of Derryinver Bay, it is represented only by dead shells, but it has been taken in the deepest part of Barnaderg Bay, where the bottom is mud covered with algae. Its principal haunt would, therefore, seem to be the more sheltered part of the channel, on a bottom consisting of muddy gravel, with abundance of dead shells and algae, swept by a considerable tide. It is not found in the soft part of Fahy Bay, and is equally absent from the deep outer parts of the harbour.

Cardium nodosum (Turton).

Ballynakill Harbour.—Three taken in Coastguard Deep.

Bofin Harbour.—One, from the Entrance.

Cardium echinatum (L.).

Ballynakill Harbour.—Represented by a shell from the channel S. of the Green Rocks.

Cardium (Laevicardium) norvegicum (Spengler).

Ballynakill Harbour.—Once taken between tide-marks at Ross Point.

Bofin Harbour.—An adult found between tide-marks in the harbour. Very young examples and shells abundant at the Entrance, 15 to 20 fath., and in Davillaun Sound.

GARIDAE.

Gari tellinella (Lam.).

[Psammobia tellinella (Jeffreys).]

Bofin Harbour.—Common at the Entrance, 15 to 20 fath.; also common in Davillaun Sound.

. . . .

Like the Norway cockle (*Cardium norvegicum*), this species has considerable leaping powers.

Gari ferroensis (Chemn.).

[Psammobia ferroensis (Jeffreys).]

Ballynakill Harbour.—Between tide-marks at Coastguard Bay—one example. Shells at the head of Fahy Bay.

Bofin Harbour.—Between tide-marks at Port Island Bay—one example.

Gari (Psammocola) depressa (Pennant).

[Psammobia vespertina (Jeffreys).]

Ballynakill Harbour.—Recent shells between tide-marks at Coastguard Bay and at the head of Fahy Bay. One living example in the channel.

Bofin Harbour.—Recent shells between tide-marks at Port Island Bay.

MYIDAE.

Mya truncata (L.).

Ballynakill Harbour.—Represented by shells in the channel, where it probably lives. It was never obtained by digging, and presumably occurs only below low-water mark, burrowing too deep for the dredge.

. . . .

Of its congener *M. arenaria*, no signs were found at Ballynakill or in the neighbourhood, though it is common in parts of Galway Bay. Possibly it affects a calcareous soil.

Corbula gibba (Olivi).

Ballynakill Harbour.—Shells between Freaghillaun and the Ship Rock, and in Derryinver Bay.

The species is rather small for a dredge suitable for the soft ground that it appears to affect. It is sometimes to be found abundantly in the stomachs of plaice from ground on which the dredge gave no indication of its presence, but plaice are scarce at Ballynakill, and no such record is available.

SOLENIDAE.

Ensis ensis (L.).

[Solen ensis (Jeffreys).]

Ballynakill Harbour.—Of large size and fairly abundant at Coastguard Bay and on the little beaches N. of the old coastguard station. Less abundant than *E. siliqua*. Shells in Coastguard Deep.

Ensis siliqua (L.).

[Solen siliqua (Jeffreys).]

Ballynakill Harbour.—Very common in Coastguard Bay and on the little beaches N. of the old coastguard station, and at the head of Fahy Bay. Shells in the channel.

Bofin Harbour.—Port Island Bay; not very abundant. Shells common at Rusheen.

Cultellus pellucidus (Penn.).

[Solen pellucidus (Jeffreys).]

Ballynakill Harbour.—Single examples dredged between Freaghillaun and the Green Rocks, and between the latter and Coastguard Point.

Bofin Harbour.—Three specimens at the entrance.

SAXICAVIDAE.

Saxicava rugosa (L.).

Ballynakill Harbour.—Only recorded from the Lithothamnion ground of Fahy Bay, from limestone fragments on the shore from Baraclady seawards, and from a small piece of limestone on the Black Rocks.

The general formation of the harbour is metamorphic schist, but the S. side of Fahy Bay is highly crystalline limestone, and fragments of limestone and erratics of granite, or the like, are frequent on all the beaches.

It is probably that *Saxicava*, which by no means confines itself to stones, has been much more often observed than recorded, since so generally distributed an organism is apt to be overlooked in tabulation.

PHOLADIDAE.

Pholas sp.

Ballynakill Harbour.—In small numbers in Freaghillaun in the submerged peat bog which uncovers at low springs.

TEREDINIDAE.

Teredo megotara (Hanley).

Bofin Harbour.—The wooden pegs of a cork buoy, used to mark moorings during the summer of 1899 in the anchorage pool, were bored by a Teredo. Ship-worm, however, does not appear to be very prevalent at Bofin, though one boat trading between there and Westport was seriously attacked by it some years previously.

The worm-borings so apparent in much of the woodwork of the island, ashore and afloat, are not of local origin, baulks which drift in from the Atlantic being an important source of the timber supply.

Hulks and boats moored in Ballynakill Harbour since 1898 do not appear to have been attacked by worm there, but in February, 1904, some very large, and probably very old, *T. megotara* were found in one of the hulks.*

ANATINIDAE.

Thracia fragilis (Pennant).

[Thracia papyracea (Jeffreys).]

var. **villosiuscula** (MacGillivray)

Ballynakill Harbour.—Dead shells twice recorded from Coastguard Deep.

Bofin Harbour.—A few dead shells at the Entrance, and in Davillaun Sound.

LYONSIIDAE.

Lyonsia norvegica (Chemnitz).

Ballynakill Harbour.—A recent shell dredged off Coastguard Bay.

SCAPHOPODA.

DENTALIIDAE.

Dentalium vulgare (Da Costa).

[Dentalium tarentinum (Jeffreys).]

Bofin Harbour.—Dredged at the Entrance, one living and several shells. Living examples also taken in Davillaun Sound.

GASTROPODA.

PROSOBRANCHIA.

PATELLIDAE.

Patella vulgata (L.).

Ballynakill Harbour.—Common in usual situations throughout the harbour.

Bofin Harbour.—Common, except in very exposed places.

Helcion pellucida (L.).

Ballynakill Harbour.—Common on Laminaria.

Bofin Harbour.—Common on Laminaria. Dead shells abundant at the Entrance.

* "Worm" is said to be common on the coast of Galway, but the animal locally denoted by that term is the Isopod *Limnoria lignorum*, *anglice* "gribble."

ACMAEIDAE.

Acmaea virginea (Müller).

[Tectura virginea (Jeffreys).]

Ballynakill Harbour.—Fairly abundant in the channel. Also taken in Roeillaun Bay, to the E. of the Black Rocks, and on the Lithothamnion ground of Fahy Bay, and, between tide-marks, on the Roeillaun and Black Rocks. Mr. Holt notes that it has the power of floating everted at the surface.

FISSURELLIDAE.

Emarginula fissura (L.).

Bofin Harbour.—Shells at the entrance, 15 to 16 fath.

Fissurella graeca (L.).

Ballynakill Harbour.—No evidence of abundance. Several recorded from the N. shore of Ross, and one small example from the Black Rocks.

Bofin Harbour.—Common under stones in the narrow (S.) gut between the outer and inner harbours.

TROCHIDAE.

Gibbula cineraria (L.).

[Trochus cinerarius (Jeffreys).]

Ballynakill Harbour.—Generally distributed and common towards low-water mark throughout the outer and inner parts of the harbour; and below low-water mark (except in Fahy, Derryinver, and Barnaderg Bays, where the bottom is muddy). Mr. Farran notes that dredged examples were, as a rule, much younger than those taken between tide-marks. Small depressed examples noted from Roeillaun Bay on one occasion, being more plentiful there than the typical form. As a rule, varieties, though of frequent occurrence, were not noted. The species is frequent, as usual, on drift Laminaria.

Bofin Harbour.—Apparently more common in the inner than in the outer harbour. Dead shells abundant off the mouth of the harbour, where small living examples have also been noted.

Gibbula magus (L.).

[Trochus magus (Jeffreys).]

Ballynakill Harbour.—This is the most abundant of the larger gastropods which inhabit the harbour. It is to be found in great numbers wherever the branching "nullipore," *Lithothamnion thapsus*, or the incrusting *Melobesia*, occurs in quantity, and would appear to feed either upon those algae or on some minute organism epizoic thereon. In consequence its chief haunt in the harbour is on the N.E. shore of Fahy Bay, where the ground accessible at low-water springs is literally covered with the calcareous algae; but, since very young examples have not been observed there, it is possible that the requisite pabulum varies with the size of the individual. Our only record of a very small specimen is from the ground between Freaghillaun and the Ship Rock.

In the adult condition the species occurs on Fahy Bar, which is in part a continuation of the Lithothamnion ground referred to, and on the outer slope of the bar. It has also been recorded from the S. shore of the bay. It is by no means uncommon in dredgings from any part of the channel between Coastguard Bay and Sligagh, and on the E. shore of Ross. Between tide-marks on the Roeillaun Rocks and on the upper part of the Black Rocks it is abundant, and occurs also in Roeillaun Bay, but not in number. A few were dredged to the E. of the Black Rocks.

There is no record of its occurrence between tide-marks in the outer part of the harbour, and although, from its very wide distribution on British coasts, its connection with *Lithothamnion thapsus* and *Melobesia* may be local rather than general, it would appear probable that in the region under consideration it is much a creature of sheltered waters, and extends to no great depth beyond the limits of low-water springs.

Bofin Harbour.—Recorded on one occasion from the S. side of the harbour below low-water mark. A few shells were dredged at the Entrance, 15 to 16 fath.

. . . .

The dog whelk, *Nassa reticulata*, seems to be an enemy of this species, since on one occasion two were found attacking an apparently living specimen, their proboscides being thrust between the shell and the operculum. If one may judge from the frequency with which it is caught in traps baited with dead fish, this Nassa is usually more interested in carrion than in living prey.

Gibbula tumida (Montagu).

[Trochus tumidus (Jeffreys).]

Bofin Harbour.—Living examples dredged on several occasions at the Entrance, 15 to 20 fath.

Gibbula umbilicata (Montagu).

[Trochus umbilicatus (Jeffreys).]

Ballynakill Harbour.—Occurs, apparently in small numbers, on both N. and S. shores of Fahy Bay (18, iii., 1905), but is much commoner in the outer part of the harbour. On the Roeillaun Rocks it appears to be, with *G. cineraria*, abundant. In the rock pools to the W. of Baraclady it is the most abundant Trochid. Between tide-marks on Freaghillaun it is, with *G. cineraria*, moderately common. The only records from below low-water mark are between Freaghillaun and the Ship Rock, and off Coastguard Bay.

Monodonta crassa (Montfort).

[Trochus lineatus (Jeffreys).]

Bofin Harbour.—Very common on rocks, not far below high-water mark, on the seaward side of Port Island, near the pigeon cave. It is equally common on the granite boulders of Blacksod quay, in Co. Mayo, and seems capable of withstanding very severe wave action, while intolerant of sheltered situations.

Calliostoma Montagui (W. Wood).

[Trochus Montacuti (Jeffreys).]

Ballynakill Harbour.—A single specimen from the channel, off Ross Point, and three from Coastguard Deep.

Bofin Harbour.—In the harbour and at the Entrance.

Calliostoma striatum (L.).

[Trochus striatus (Jeffreys).]

Bofin Harbour.—Labelled as from Port Island Bay; haul of tuck net, a kind of seine.

It may have been picked up at extreme low-water at the time the haul was made, or found on weed in the net; but as there is no entry in the laboratory records, the origin of the specimen is, as regards the particular part of the harbour, a little doubtful.

Calliostoma miliare (Brocchi).

[Trochus millegranus (Jeffreys).]

Ballynakill Harbour.—Fahy Bay, Channel, Coastguard Deep and inside Freaghillaun.

Bofin Harbour.—Twice recorded from the Entrance.

Calliostoma zizyphinum (L.).

[Trochus zizyphinus (Jeffreys).]

Ballynakill Harbour.—Our records indicate that this is not a species very tolerant of sheltered waters. Its occurrence in the inner part of the harbour has only once been noted, but whether from Fahy Bay, or from the neighbourhood of Sligagh, the record is not sufficiently precise to show. It has been observed between tide-marks on the Roeillaun Rocks, on the Black Rocks (in abundance), on Freaghillaun (in moderate numbers), and in the rock-pools seawards of Baraclady (several). It is altogether absent from the records of numerous dredgings in all parts of the harbour, but has been taken outside the mouth, and in Sellerna Bay, near Cleggan.

Bofin Harbour.—Once recorded from the outer harbour between tide-marks.

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The absence of *C. granulatum*, especially from the grounds outside the harbours, as far as they have been explored, is perhaps worthy of remark.

TURBINIDAE.

Phasianella pullus (L.).

Ballynakill Harbour.—Scarce in the inner part of the harbour, being only recorded once from Fahy Bay, the channel off Fahy Bar, and from the edge of the sandbank off Coastguard Bay respectively. In the outer part it has been taken in the channel S. of the Green Rocks (numerous), from the channel S.W. of, and close to, the Black Rocks, from Freaghillaun Deep and from the mouth of the harbour.

Bofin Harbour.—Taken once on the S. side of the outer harbour below low-water mark, and on several occasions on the shelly bottom of the Entrance, 15 to 20 fath.

LITTORINIDAE.

Lacuna divaricata (Fabr.).

Ballynakill Harbour.—Moderately abundant, perhaps common, in the channel off Fahy Bay and Ross. Also taken in Fahy Bay, Roeillaun Bay, 1½ fath., and S.W. of the Black Rocks, close into them. There is a doubtful record from Coastguard Deep.

Bofin Harbour.—Recorded once from the outer harbour, between the castle and the anchorage pool, and once, in abundance, from a part of the harbour not defined.

Littorina littorea (L.).

Ballynakill Harbour.—Common on all the suitable shores of the harbour which have been explored; and on Freaghillaun, the Black Rocks and Roeillaun Rocks. Collected for market at every low strand throughout the year. Perhaps partly on this account, really large specimens are not abundant.

Bofin Harbour.—Common. Not regularly collected for market.

Littorina obtusata (L.).

[Littorina littoralis (Forbes and Hanley.)]

Ballynakill and Bofin Harbours.—Common in the usual situations.

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No search has been made for *L. rudis* in the situations where it would be likely to occur.

RISSOIDAE.

Rissoa parva (Da Costa).

Ballynakill Harbour.—Fahy Bay, N. and S. shores, and Bar, Channel, Coastguard Deep and Roeillaun Bay. The var. *interrupta* is commoner than the type.

Bofin Harbour.—Port Island Bay, and W. of the anchorage pool, variety and type, abundant, and one record of type from entrance.

Rissoa albella (Löven), var. Sarsi (Löven).

Ballynakill Harbour.—Very common in Fahy Bay from Rossdhu to Knocknahaw on the hardish ground about low-water mark, and also on the soft muddy Cladophora-clad central parts. Occurs also in the channel.

Rissoa violacea (Desm.).

Ballynakill Harbour.—Taken on the Lithothamnion ground of Fahy Bay, in the channel, in Roeillaun Bay, at the month of Derryinver Bay and off the Ship Rock.

Alvania punctura (Montagu).

[Rissoa punctura (Jeffreys).]

Ballynakill Harbour.—Coastguard Deep and mouth of Derryinver Bay.

Manzonia costata (J. Adams).

[Rissoa costata (Jeffreys).]

Ballynakill Harbour.—Twice taken in Coastguard Deep.

Zippora membranacea (Adams).

[Rissoa membranacea (Jeffreys).]

BALLYNAKILL HARBOUR.—Channel off Fahy Bay and Ross, and Roeillaun Bay. Var. *labiosa* recorded from the Lithothamnion ground in Fahy Bay and from Roeillaun Bay. A doubtful record from the channel N. of the Black Rocks. Common off the Ship Rock.

BOFIN HARBOUR.—Between the quay and the anchorage pool.

Onoba striata (Adams).

[Rissoa striata (Jeffreys).]

BALLYNAKILL HARBOUR.—Abundant on one occasion in the deep part of the channel off Fahy Bay.

Also taken in Coastguard Deep and Roeillaun Bay.

Cingula trifasciata (J. Adams).

[Rissoa cingillus (Jeffreys).]

BOFIN HARBOUR.—Entrance, ½ mile from Gun Rock.

Barleeia rubra (Montagu).

BOFIN HARBOUR.—Dead shells from the shell-ground at the entrance.

CAPULIDAE.

Crepidula fornicata (L.).

See note under *Ostrea edulis.*

CYPRAEIDAE.

Trivia europaea (Montagu).

[Cypraea europaea (Jeffreys).]

BALLYNAKILL HARBOUR.—Appears to be common and generally distributed throughout the harbour, between and below tide-marks, except on absolutely muddy ground. Common also in the channel off Ross and Fahy Bay.

BOFIN HARBOUR.—Common, especially about the shore of Glasillaun facing the outer harbour.

NATICIDAE.

Natica catena (Da Costa).

BOFIN HARBOUR.—A few small specimens at the Entrance, 15 fath.

Natica Alderi (Forbes).

BALLYNAKILL HARBOUR.—On the edge of the sandbank of Coastguard Bay, in the channel off it, and in the deeper part of the channel off Fahy Bay. In the outer part of the harbour between Freaghillaun and the Ship Rock, and between Freaghillaun and the Green Rocks.

BOFIN HARBOUR.—In the anchorage pool and at the Entrance.

Also in Davillaun Sound.

LAMELLARIIDAE.

Lamellaria perspicua (L.).

Ballynakill Harbour.—Near the Green Rocks, 3 to 4 fath., and between tide-marks on the E. of Ross. Common on S. shore of Fahy Bay and in the channel.

Bofin Harbour.—Between tide-marks. Also larvae (Echinospira) in tow-nets.

IANTHINIDAE.

Ianthina rotundata (Leach).

Pl. XIV., Fig. 6.

Bofin Harbour.—I quote the following from Mr. Holt's notes:—"On July 28th, 1899, Mr. W. S. Green found many living *Ianthina* coming ashore on the 'White Strand' of Bofin (*i.e.*, the strand just S. of Granuaile's Cliff on the Sound between Bofin and Shark). There were also on the strand the skeletons of *Velella*, the rest having been eaten by Amphipods, and a small perfect shell of *Spirula*. These were seen a few days afterwards by Mr. Woodward and myself, one of the *Ianthinae* having been kept alive for a time in a vessel of water, and having therein added to its float. On the 4th August we went to the White Strand, and found a few large shells of *Ianthina* and one skeleton of a very large *Velella*. A few days later we found a shell of *Ianthina* on the shore of Bofin Harbour."

The figure is taken from a drawing by Mr. Woodward.

CERITHIIDAE.

Bittium reticulatum (Da Costa).

[Cerithium reticulatum (Jeffreys).]

Ballynakill Harbour.—Appears to be common throughout the channel; occurs also in Derryinver Bay, and on the Lithothamnion ground in Fahy Bay.

Bofin Harbour.—A number of large specimens taken at night in a tow-net dragged along the sandy bottom between the quay and the anchorage pool. Shells, and some living, on the shell-ground at the entrance.

Triforis perversa (L.).

[Cerithium perversum (Jeffreys).]

Ballynakill Harbour.—Recorded once from the channel.

Bofin Harbour.—Dead shells recorded once from the outer harbour. Frequent on the shell-ground at the entrance.

Cerithiopsis tubercularis (Montagu).

Bofin Harbour.—One record, from the sandy ground between the quay and the anchorage pool.

SCALIDAE.

Scala clathrus (L.).

[Scalaria communis (Jeffreys).]

BALLYNAKILL HARBOUR.—Though a familiar and conspicuous form, this mollusc was not noticed in the harbour previous to 1901, since when it has been commonly taken on grounds often searched in the two preceding years. It has been recorded in March, April, May, July, and November, and is not, therefore, merely a seasonal visitant of the beach. The N. and S. shores of Fahy Bay appear to be its principal habitat, but it is not uncommon on the E. shore of Ross. Here several (ranging in size up to 3.7 cm.) were found in pairs in May, and one was taken with spawn in July, 1901. A specimen is also recorded from the shore of the outer part of the harbour, W. of Baraclady.

BOFIN HARBOUR.—A small specimen between tide-marks (at lowest springs) in the outer harbour. Shell, with hermit, in the anchorage pool. Shells occur on Knock beach.

Scala clathratula (Adams).

[Scalaria clathratula (Jeffreys).]

BALLYNAKILL HARBOUR.—Twice taken in the channel off Fahy Bay, including the deepest part.

PYRAMIDELLIDAE.

Odostomia acuta (Jeffreys).

BALLYNAKILL HARBOUR.—One record from the deep part of the channel off Fahy Bay. A young example from Coastguard Deep.

Odostomia unidentata, F. & H.

BALLYNAKILL HARBOUR.—Fahy Bay and Channel, two specimens.

Pyrgostelis interrupta (Totten).

[Odostomia rufa v. fulvocincta (Jeffreys).]

BALLYNAKILL HARBOUR.—One from Coastguard Deep.

Eulimella commutata (Mont.).

[Odostomia acicula (Jeffreys).]

BALLYNAKILL HARBOUR.—Two from Coastguard Deep.

Turbonilla lactea (L.).

[Odostomia lactea (Jeffreys).]

BALLYNAKILL HARBOUR.—Roeillaun Bay.

BOFIN HARBOUR.—One record, from between tide-marks, between the lobster pond and the castle.

Turbonilla indistincta.

BALLYNAKILL HARBOUR.—Coastguard Deep.

EULIMIDAE.

Eulima polita (L.).

Ballynakill Harbour.—Taken on several occasions in Coastguard Deep, and between Coastguard Point and the Green Rock.

Eulima incurva (Renier).

[**Eulima distorta** (Jeffreys).]

Ballynakill Harbour.—Fairly abundant, in one haul, in the outer part of the harbour between Freaghillaun and the Ship Rock. Also taken in the channel off Ross and Fahy Bay, including the deepest part off the Bar, and once in Coastguard Deep (six specimens).

Eulima (Leiostraca) bilineata (Alder).

Ballynakill Harbour.—One record, from the deep part of the channel off Fahy Bay.

Bofin Harbour.—Two taken at the Entrance, 17 fath.

TURRITELLIDAE.

Turritella communis (Lamarck).

[Turritella terebra (Jeffreys).]

Ballynakill Harbour.—The distribution of this species in the harbour appears worthy of special note, since it seems to be commonest and to attain its largest size between tide-marks on the muddy gravel of Rossdhu beach, on the S. side, and near the head of Fahy Bay. It has not been found there below low-water mark, and is not otherwise known as an inhabitant of the Bay. The beach in question could not, from its orientation, be the receptacle of any object thrown up by violent wave action; N.E. to E. winds of any force being most exceptional, while the tidal currents in the bay are very gentle.

A single example is recorded from the channel off Fahy Bay. Others have been taken in Coastguard Deep, and on the strand of Coastguard Bay, while the presence of shells seems to indicate the Deep as a regular haunt of the species. Rather small specimens occur regularly in Freaghillaun Deep, and, as far as our records serve to show, between Freaghillaun and the Ship Rock, and in Derryinver Bay, but not commonly in the latter.

Bofin Harbour.—Occurs, but not abundantly, in the anchorage pool. Not observed between tide-marks.

BUCCINIDAE.

Buccinum undatum (L.).

Ballynakill Harbour.—Abundant at all stages of growth between tide-marks in Fahy Bay; on the Ross peninsula, and in the channel off Fahy Bay. Also observed between tide-marks on the Roeillaun Rocks and Freaghillaun, and in the channel E. of the Black Rocks, and in Roeillaun Bay. Probably more generally distributed in the harbour than the records indicate. Spawning takes place extensively between tide-marks in Fahy Bay and on Ross; the actual operation has been only noted in October and November, but live spawn masses are to be found from that period until August, when the young have been observed hatching.

The species does not attain a large size in the harbour, and does not appear to be fished anywhere in the neighbourhood, either for commercial purposes or for bait.

Bofin Harbour.—Not recorded.

MURICIDAE.

Ocinebra erinacea (L.).

[Murex erinaceus (Jeffreys).]

BALLYNAKILL HARBOUR.—Observed between tide-marks in Fahy Bay (spawning early in April and early in May, 1902), on the E. shore of Ross, on Dawros, on the Roeillaun Rocks, and on the Black Rocks. Also taken in the channel off Ross. The oyster bed of Dawros, where the species might be supposed to occur most commonly, has not been examined. At Plymouth this mollusc appears to take refuge in winter in piles of stones, with a certain amount of mud, in sheltered situations, but no similar sanctuary has been met with at Ballynakill. At Arcachon, where it is greatly dreaded on account of its ravages on spat oysters, it is said to disappear as soon as the weather turns cold.

BOFIN HARBOUR.—Observed once on the seaward face of Glasillaun.

Purpura lapillus (L.).

BALLYNAKILL HARBOUR.—Does not appear to be very abundant in the places where note has been taken of its occurrence; but so universally distributed a species, living above the area usually devoted to shore-collecting, almost inevitably escapes careful attention. It is certainly not rare on any stony part of the shore of the harbour, but seems to be most abundant in the outer part.

BOFIN HARBOUR.—Occurs in the usual situations. No special note as to its abundance.

NASSIDAE.

Nassa reticulata (L.).

BALLYNAKILL HARBOUR.—Common in the usual situations throughout the harbour.

BOFIN HARBOUR.—Common.

Nassa incrassata (Ström).

BALLYNAKILL HARBOUR.—Abundant in the channel off Ross and Fahy Bay; also taken in Coastguard Deep, in Roeillaun Bay, and in the outer part of the harbour between Freaghillaun and the Ship Rock, and between tide-marks on the Black Rocks and Freaghillaun. Shells only in Freaghillaun Deep. Generally distributed in summer on the E. shore of Ross (except Coastguard Bay), and on the N. shore of Fahy Bay, but not observed there in the winter.

BOFIN HARBOUR.—In the outer harbour on Glasillaun. Between and below tide-marks between the lobster pond and the castle. Occurs also on the shell-ground at the Entrance.

PLEUROTOMIDAE.

Bela turricula (Mont.).

BALLYNAKILL HARBOUR.—Thrice recorded from Coastguard Deep; also taken between Coastguard Point and Green Rocks.

Haedropleura costata (Da Costa).

[Pleurotoma septangularis (Jeffreys).]

BALLYNAKILL HARBOUR.—Recorded on three occasions from the channel off Ross and Fahy Bay, and from Coastguard Deep respectively; once from between Coastguard Point and the Green Rocks.

Mangilia attenuata (Montagu).

[Pleurotoma attenuata (Jeffreys).]

Ballynakill Harbour.—Channel and Coastguard Deep, two records.

Mangilia costata (Donovan).

[Pleurotoma costata (Jeffreys).]

Ballynakill Harbour.—Recorded from the channel off Fahy Bay, off Coastguard Bay, Coastguard Deep, in Roeillaun Bay and S. of the Green Rocks. Also the var. *coarctata* from Coastguard Bay.

Bofin Harbour.—Recorded twice.

Mangilia nebula (Montagu).

[Pleurotoma nebula (Jeffreys).]

Ballynakill Harbour.—Coastguard Deep.

Bofin Harbour.—Taken in small numbers on the shell-ground at the Entrance, including the var. *elongata*, Jeff. ; and in the harbour, once. Occurs also in Davillaun Sound.

Mangilia striolata (Scacchi).

[Pleurotoma striolata (Jeffreys).]

Ballynakill Harbour.—Channel off Ross Point and off Coastguard Bay.

Bofin Harbour.—A single example from the shell-ground at the Entrance.

Clathurella linearis (Montagu).

[Defrancia linearis (Jeffreys).]

Ballynakill Harbour.—A single specimen from the channel off Fahy Bay. Thrice recorded from Coastguard Deep.

Bofin Harbour.—A single specimen, var. *intermedia* [*aequalis*, Jeffreys], at 15 fath. in the Entrance.

Clathurella purpurea (Montagu).

[Defrancia purpurea (Jeffreys).]

Ballynakill Harbour.—A single record, from the mouth of Roeillaun Bay, 1½ fath.

Bofin Harbour.—A single record, from the shell-ground at the Entrance.

Clathurella Leufroyi.

[Defrancia Leufroyi (Jeffreys).]

Ballynakill Harbour.—Seven specimens from Coastguard Deep.

OPISTHOBRANCHIA.

SCAPHANDRIDAE.

Scaphander lignarius (L.).

Ballynakill Harbour.—A single record, from between Freaghillaun and the Ship Rock.

Bofin Harbour.—A single record, from the Entrance.

BULLIDAE.

Acera bullata (Müller).

Ballynakill Harbour.—This mollusc is represented in the harbour by the large variety, the greatest length of shell being 1·6 in. The exposed part of the shell is not infrequently (at least in summer) adorned with a plume of alga—Enteromorpha or the like, having something of the appearance of a tail.

The distribution of the species in the harbour is, owing to its flitting habit, somewhat difficult to define exactly. Probably it chiefly affects mud or soft muddy sand well below tide-marks, such as the centre of Derryinver Bay, where it was taken in quantity in April and August, 1900. It has not, however, been constantly met with there, and may either be variable in its haunt or confined to particular areas which our nets did not always reach, or may, as my own experience in English waters leads me to suppose, undertake definite migrations. At low spring-tide in August, 1899, it was swimming in great abundance throughout the channel between Knocknahaw, Roscreagh, and Dawros, the weather being particularly warm and fine. At the corresponding spring-tide of the following year, in weather not very different, no specimens could be got in this part of the harbour, and an extensive search located the species as apparently confined to Derryinver Bay. A specimen was taken in a herring net off Roscreagh in September, 1902, and may probably have been swimming when it met the net. A few were found in the S. corner of the deep part of Barnaderg Bay in July, 1901, but this bay has not been sufficiently explored to allow of an opinion in regard to the regularity of the occurrence of the species there. The bottom is soft and muddy. In November, 1901, it was found in abundance crawling on the muddy ground in Fahy Bay, off Rossdhu, its spawn being also present. No specimens were observed swimming. This ground, which is at the usual landing-place of boats from the laboratory, is pretty well known, and it is certain that *Acera* is not always, if often, there. It has never been dredged in Fahy Bay, though the 2 fath. hole towards Knocknahaw would seem to fulfil all its requirements in the matter of bottom and depth.

The foregoing remarks relate only to adults. The young seem to be more frequently pelagic, and have been taken in tow-nets in Fahy Bay, sometimes at night, in April, May, August, and October. The haul in Barnaderg Bay, previously mentioned, included a great number of very small examples referred to this species.

Its absence, in either adult or young condition, from the outer part of the harbour, is not explicable either by paucity of search or by the want of apparently suitable ground; and although young examples were captured on two occasions in the open sea far outside the harbour, it is perhaps on the W. coast, if not elsewhere, chiefly a creature of sheltered waters, confined, as to its more sedentary habitat, to soft muddy or muddy-sand grounds, but schooling at times in late summer and autumn over any neighbouring ground.

The large form of the species also occurs in Aughinish and Muckinish Bays, Co. Clare. Smaller recent shells (not exceeding one inch in length) were found in number in the upper section of the Ardfry "Saleen"

(sea-pond), off New Harbour, which, like the bays mentioned above, is an inlet of Galway Bay. This upper section is only reached by the tide at springs, and the shells found there evidently represented the remains of living examples killed by the artificial drying of the pond for some days previously. The bottom is soft mud, and the water, isolated during neap tides, naturally varies much more in salinity and temperature than the water of the bay. It is possible that these circumstances, as apart from mere question of food supply, may in part explain the small size of the individuals as compared with those of immediately neighbouring waters.

TORNATINIDAE.

Tornatina truncatula (Brug.).

BALLYNAKILL HARBOUR.—A single specimen from Coastguard Deep.

PHILINIDAE.

Philine aperta (L.).

BALLYNAKILL HARBOUR.—Abundant, and reaches a very large size in the deepest part of Fahy Bay, 2 fath. at low-water, about N.N.E. of Knocknahaw point, soft muddy sand with no Cladophora. Common also in Coastguard Deep, Derryinver Bay, and in the outer part of the harbour, wherever the bottom is suitable. Not observed in Barnaderg Bay.

The unusual size attained in Fahy Bay may be due to immunity from the attack of soles and dabs, which are partial to it, and (except very young dabs) are never found in the Bay. There is a single record of the occurrence of *Philine* in the stomach of a white trout taken in the Bay, but this fish is only an occasional visitant, chiefly at spring tides in the late summer.

The spawn of *Philine* may have been previously described. It consists of rather amorphous masses of a transparent colourless jelly, in which are imbedded minute ova of a yellowish brown tint. These masses are often much larger than the parent mollusc. They are not attached to anything, but the lighter particles of the muddy sand on which they are found often adhere to them.

LIMACINIDAE.

Limacina retroversa (Flem.).

[Spirialis retroversus (Jeffreys).]

BOFIN HARBOUR.—Having been taken across the Entrance, it may be safely inferred that this form occasionally enters the harbour, especially after autumn gales, though it is in no sense a harbour species.

APLYSIIDAE.

Aplysia punctata (Cuvier).

BALLYNAKILL HARBOUR.—Apparently not very abundant in any part of the harbour, though usually met with in the outer part, and on one occasion—in a haul of the trawl off Letterbeg, in June, 1902—recorded as numerous. Not found in Derryinver Bay, and rare in the channel south of Coastguard point. Represented in Fahy Bay only by two very small examples taken in June, 1902. Seldom observed between tide-marks in any part of the harbour.

BOFIN HARBOUR.—Rare; represented by three large examples taken in Port Island Bay. A young example was taken in a surface townet between Inisgort and the mouth of the harbour. It may have been clinging to drift weed.

PLEUROBRANCHIDAE.

Pleurobranchus plumula (Montagu).

BALLYNAKILL HARBOUR.—Appears to be generally distributed between tide-marks throughout the harbour, since there are records from N. and S. shores of Fahy Bay, E. and N. shores of Ross peninsula, Dawros, Baraclady, and Freaghillaun. Occurs also in the channel, including the deepest part, off Fahy Bay. A pair were observed with spawn on the E. shore of Ross in May, 1901.

BOFIN HARBOUR.—Exceedingly common in June, 1899, between tide-marks in the cove between the lobster pond and the castle; somewhat less abundant on the outer face of Glasillaun. Pairing was then in full progress, and may have accounted for the species attracting more notice than usual. When search was made in August of the same year at Glasillaun, only a few could be found.

Work at Bofin was confined to the months May to September (inclusive), but at Ballynakill the shores have been searched at low spring tides throughout the year, and dredging has been equally continuous. *Pleurobranchus*, however, appears never to have been met with between October and January (inclusive). Its usual haunt is on or under large stones (more or less muddy), near the limit of spring tides, especially perhaps where the shore consists of such stones piled one on the other. Possibly the large individuals die off immediately or soon after spawning; but if they survive and retire in the late months of the year to similar ground below tide-marks, a dredge could give no account of them.

Oscanius membranaceus (Montagu).

[Pleurobranchus membranaceus (Jeffreys).]

BALLYNAKILL HARBOUR.—Large examples (but not so large as have been taken by the Marine Biological Association in Gerran's Bay, Cornwall) were found rather commonly in February, 1899, on the shore of Coastguard Bay, and in Fahy Bay under Rossdhu. In August of the same year only one was met with, on Fahy Bar, in a search extending over the shores of all the inner part of the harbour, except Barnaderg Bay and the Moyard Creek. One was found on Ross shore in March, 1900.

Subsequent records refer to two small examples from the outer part of the harbour in January, 1902, and one in the channel off Coastguard Bay in November, 1902.

Oscanius can swim fairly well by semi-rotary and by no means graceful movements of the "umbrella," and possibly attempts seasonal migrations, which must be greatly influenced by tide and weather. It is too large, and not sufficiently active, to have escaped nets when present on the ground fished over; and on the whole it seems probable that the specimens which have from time to time been brought to hand have been immigrants from the outer world, and not derived from any centre of distribution within the harbour.

RUNCINIDAE.

Runcina coronata (Quatrefages)

[Runcina Hancocki (Jeffreys).]

BOFIN HARBOUR.—Once taken in a surface tow-net between the post office and the anchorage pool at 11 p.m., 8/9/1899. There was some weed in the net.

CEPHALOPODA.

SPIRULIDAE.

Spirula Peroni (Lamarck).

See p. 72.

LOLIGINIDAE.

Loligo Forbesi (Steenstrup).

Bofin Harbour.—Several, full-grown, seined in the anchorage-pool in September, 1899, and October, 1900. Apparently absent earlier in either year, as the net was frequently used in the same place, both by day and night. Examination of the records of fish appears to indicate that the squid may have followed either young grey gurnard, which enter the harbour in the autumn, or young coalfish, which, though always present to some extent, become very much more abundant at that time.

SEPIOLIDAE.

Sepiola.

Ballynakill Harbour.—Not recorded, but certainly taken occasionally. (*Fide* E. W. L. H.).

Bofin Harbour.—Not uncommon.

. . . .

Both the names of *scandica* (=*Rondeleti*) and *atlantica* occur in the records, but there seems to be doubt whether both species really occur, or whether the same has been noted with both names.

POLYPODIDAE.

Moschites cirrhosa (Lam.).

[Eledone cirrhosa (Jeffreys).]

Bofin Harbour.—Seined in autumn in the anchorage pool on several occasions in 1899 and 1900. Mostly large or moderate size; one small.

An octopod, probably referable to this species, was once observed on the shore of Fahy Bay in Ballynakill Harbour.

THE DEEP-WATER MOLLUSCS OF THE WEST AND SOUTH-WEST COAST.

I am informed that, during the cruises which yielded the material dealt with below, dredging was only attempted when time permitted, the main objects being trawling, line-fishing, or tow-netting, as the case might be. Moreover, the dredges used were hardly fine enough in the mesh to secure any but the larger forms, nor sufficiently biting for mollusc work. The

account I am able to give of the molluscan fauna of the ground worked over is therefore of the most meagre description.

Details of locality, depth and date of hauls are given in the table below, and in the pages which follow the origin of the specimens is only indicated by the station number. It will be observed that Stations LXXVII. and LXXIX. are respectively on and just inside the Porcupine Bank.

The *Helga* works over certain deep-water grounds once every three months, and during the writing of these notes fresh collections have been continually placed in my hands. To incorporate everything has been impossible, but I have tabulated every record of importance up to May, 1904.

Statements of the catch refer to the station numbers which precede them with the intervention of commas only. When a station number (or numbers separated by commas) precedes a semi-colon or full-stop, without definition of catch, it is to be understood that the species was taken alive. "Dead," in the case of Lamellibranchs, signifies that the shell was found complete, "valves" denoting separated valves. In the laboratory records, from which Part I. of this paper was in part compiled, I understand that "shells" may be taken to signify either complete shells or odd valves.

Station. "HELGA" Series.	APPROXIMATE. Distance and Bearings (Mag.) from Cleggan Head.	Lat. N. °	Long. W. °	Depth by Sounding. Fath.	Nature of bottom and Net, unless Dredge.	Date.
LXXIII.*	40 m. N.W. by N., ...	53° 56′	11° 04′	105	Fine sand, ...	18.6.01
LXXIV.	30 m. N.W. by N., ...	53° 50′	10° 49′	88	Fine sand, ...	18.6.01
LXXVII.	124 m. W. by N. ½ N.,	53° 24′ 30″	13° 36′	91	Coarse sand, stones.	29.6.01
LXXIX.	90 m. W. by N. ½ N.,	53° 23′	12° 43′	175	Fine sand (bottom townet).	29.6.01
LXXXV.	40 m. N., ...	54° 11′	10° 33′	87	Sand and stones,	5.7.01
LXXXVIII.	40 m. W.N.W., ...	53° 34′	11° 15′	78 (by Chart)	Sand, gravel, stones.	8.7.01
XC.	40 m. W. by S., ...	53° 11′	11° 03′	76	Fine sand, ...	9.7.01
CXIV.	40 m. S.W., ...	52° 57′ 30″	10° 33′	62½	Sand, stones, ...	2.8.01
CXVII.	30 m. W.N.W., ...	53° 34′	10° 58′	75½	Sand, shells, small black gravel, stones.	23.8.01
CXVIII.	(CXVII. S.E 5 m.), ...	53° 38′	11° 02′ 30″	—	(Surface townet, 10.15-10.25 p.m.)	23.8.01
CXXI.	64 m. N.W. ½ W., ...	53° 52′	11° 56′	199	Fine sand (trawl),	24.8.01
CXXIX.	40 m. W.N.W., ...	53° 34′	11° 15′	76½	Large and small stones.	11.9.01
CXXXI.	50 m. W.N.W., ...	53° 34′	11° 32′	110	Fine sand, ...	12.9.01
CXXXII.	50 m. N.W. by N., ...	54° 02′	11° 17′ 30″	135	Fine sand, ...	13.9.01
CXXXIII.	40 m. N W. by N., ...	53° 56′	11° 04′	100	Fine sand, ...	13.9.01
A. I.	20 m. W.N.W., ...	53° 34′	10° 41′	72½	Coarse shelly sand and rocks.	14.8.02
*A. II.	50 m. W.N.W., ...	53° 34′	11° 32′	116	Fine dark sand,	15.8.02
A. IV.	40 m. W.N.W., ...	53° 34′	11° 15′	95	Sand and gravel,	18.8.02

* This station number, followed in text by a different date in brackets, indicates another haul over same ground.

AMPHINEURA.

CHITONIDAE.

Craspedochilus onyx (Spengler).

[Chiton cinereus (Jeffreys).]

LXXIV., LXXXVIII., CXIV., CXVII.

Callochiton laevis (Mont.).

[Chiton laevis (Jeffreys).]

A IV., one.

PELECYPODA.

NUCULIDAE.

Nucula nucleus (L.). ?

CXVII., four valves.

Nuculana tenuis (Philippi).

[Leda pygmaea (Jeffreys).]

CXVII., valve; A I., valve; A II., three living, one valve; 50 mi. W.N.W. of Tearaght, 7/8/'03, valve.

ANOMIIDAE.

Anomia ephippium (L.).

LXXIV.; CXXI., one young specimen; CXXXI., on shells of gastropods; A I., young valves.

Anomia striata (Brocchi).

CXIV., one valve; CXVII., one valve; A IV., one valve. All referred here with some slight hesitation.

ARCIDAE.

Glycymeris glycymeris (L.).

[Pectunculus glycimeris (Jeffreys).]

CXXXIII., one valve.

Arca tetragona (Poli).

LXXXVIII., CXVII., A I., valves.

Bathyarca pectunculoides (Scacchi).

[Arca pectunculoides (Jeffreys).]

CXXI., one.

MYTILIDAE.

Mytilus sp.

CXVII., fry.

Volsella adriatica Lamarck)

[**Mytilus adriaticus** (Jeffreys.]

CXVII., valve.

PTERIIDAE.

Pinna fragilis (Pennant).

[**Pinna rudis** (Jeffreys).]

LXXIV., fragment; CXXXII., fragment.

PECTINIDAE.

Pecten (Chlamys) islandicus (Müll.

LXXVII., broken valve.

Pecten (Chlamys) varius (L.).

LXXIV., valve.

Pecten (Aequipecten) opercularis (L.).

LXXIII., valves; LXXIV., valves; XC., 20 valves; A I., one young.

Pecten (Peplum) clavatus (Poli), var. **Dumasi** (Payr.)

LXXXV., valve.

Pecten (Palliolum) tigerinus (Müll.).

LXXIV., valve; LXXXVIII., CXIV., valve; CXVII., valves; CXXIX.; CXXXIII., valves; A I., fourteen young.

Pecten (Palliolum) similis (Laskey).

LXXIX., valve; CXVII., valves; CXXI., 300 *circ.*; A I., three and valves; A II., two and valves. Same locality, August, 1903, twenty-three in two hauls.

LIMIDAE.

Lima subauriculata (Montagu).

CXVII., valves; A I., two.

ASTARTIDAE.

Astarte sulcata (Da Costa).

CXVII., valves; CXXXIII., (?); LXXXVIII., dead; XC., one and valve; 20 mi. W.N.W. of Black Rock, Co. Mayo, valve.

Astarte borealis (Chemn.).

70 mi. S.W. of Fastnet Rock, Co. Cork, 80 fath., 11/5/'03, one valve.

CYPRINIDAE.

Cyprina islandica (L.).

LXXIV., broken valve; XC., valve.

LUCINIDAE.

Lucina borealis (L.).

XC., two young valves.

Thyasira flexuosa (Montagu).

[Axinus flexuosus (Jeffreys).]

XC., two valves.

Cryptodon ferruginosum (Forbes).

[Axinus ferruginosus (Jeffreys).]

A II., five; 50 mi. W.N.W. of Tearaght, 7/8/'03, two broken.

SCROBICULARIIDAE.

Syndosmya prismatica (Mont.).

[Scrobicularia prismatica (Jeffreys).]

CXVII., fragment; A I., one, and two valves.

Syndosmya alba (Wood). ?

[Scrobicularia alba (Jeffreys).]

CXXI., one young, dead.

Syndosmya nitida (Müll.).

[Scrobicularia nitida (Jeffreys).]

A II., two.

TELLINIDAE.

Macoma calcarea (Chemn.).

A single valve, taken in the same haul as *Astarte borealis*, 70 mi. S.W. of Fastnet.

MACTRIDAE.

Mactra stultorum (L.).

LXXIV., fragment; A I., fry, doubtfully referred here.

Mactra (sp.).

CXVII., valve.

Spisula solida (L.).

CXVII., two valves (approaching the *S. elliptica* (Brown), which is, I think, really only a variety); XC., fragment.

Spisula elliptica (Brown).

[Mactra elliptica (Jeffreys).]

A I., valve.

VENERIDAE.

Dosinia lupina (L.).

[Venus lincta (Jeffreys).]

[Artemis lincta (F. & H.).]

LXXIII., valves; LXXIV., LXXXVIII., dead; XC., CXXXI., valves; CXVII., valve; 20 mi. W.N.W. of Black Rock, Co. Mayo; 120 fath., valves.

Venus (Ventricula) casina (L.).

LXXIV., valve; LXXXVIII., dead; CXVII., valves; A I., young valve.

Venus (Timoclea) ovata (Pennant).

LXXIV., valves attached to worm tubes; XC., four valves; CXXXI., valve; CXXXIII., valves; A I., A II., A IV., valves.

Venus (Chamelaea) gallina (L.).

XC., three valves; CXIV., valves, the sculpture fine and deep.

Gouldia minima (Montagu).

[Circe minima (Jeffreys).]

CXVII., four valves.

CARDIIDAE.

Cardium echinatum L.).

LXXIII., valve; XC., valves; CXXXI., valve.

Cardium tuberculatum (L.).

LXXIII., CXIV., valves.

Cardium exiguum (Gmel.).

50 mi. W.N.W. of Cleggan Head, 17/8/'03, one.

Cardium nodosum (Turton). ?

A I., A II., valve and broken shell; 50 mi. W.N.W. of Cleggan Head 116 fath., 17/8/'03, five.

Cardium (Laevicardium) norvegicum (Spengler).

LXXXV., fragment.

Cardium (sp.).

CXXI., several young specimens, which may belong to *C. echinatum.*

GARIDAE.

Gari ferroensis (Chemn.).

[Psammobia ferroensis (Jeffreys).]

LXXIV., valve.

Gari costulata (Turton).

[Psammobia costulata (Jeffreys).]

CXVII., valve, and fragment?

MYIDAE.

Corbula gibba (Olivi).

A II., two valves.

SOLENIDAE.

Ensis [Solen] (sp.).

XC., fragment.

SAXICAVIDAE.

Saxicava arctica (L.)

[Saxicava rugosa, var. (Jeffreys).]

CXVII., valves; CXXXI., two.

Saxicava rugosa (L.).

CXXXI., one; A I., one.

ANATINIDAE.

Thracia fragilis (Penn.).

[Thracia papyracea (Jeffreys).]

XC., large fragment, apparently belonging to the var. *villosiuscula*; CXVII., one young, dead valve.

CUSPIDARIIDAE.

Cuspidaria abbreviata (Forbes).

[Neaera abbreviata (Jeffreys).]

CXXI., several.

Cuspidaria cuspidata (Olivi)

[Neaera cuspidata (Jeffreys).]

XC., valve.

Pandora inaequivalvis (L.).

A II., fragment.

SCAPHOPODA.

DENTALIIDAE.

Dentalium entalis (L.).

LXXIII., one dead, broken; LXXIV., LXXVII., dead; CXVII., one (dead?) and fragment; CXXXII., one (dead?).

GASTROPODA.

PROSOBRANCHIA.

LEPETIDAE.

Lepeta fulva (Müll.).

[**Tectura fulva** (Jeffreys.).]

LXXXVIII., CXIV., (dead?), CXVII., A I., six.

PLEUROTOMARIIDAE.

Scissurella crispata (Flem.).

CXVII., three dead; A I., one.

FISSURELLIDAE.

Puncturella noachina (L.).

LXXXV., CXIV., CXVII., dead; A I., four.

Emarginula fissura (L.).

CXVII., dead; A I., one.

Propilidium ancyloide (Forbes).

CXVII., two dead; A I., one.

TROCHIDAE.

Gibbula magus (L.).

[**Trochus magus** (Jeffreys).]

LXXIII., one, of an elevated form.

Gibbula umbilicata (Montagu)

[**Trochus umbilicatus** (Jeffreys).]

LXXIII., one young, dead.

Calliostoma Montagui (Wood).

[**Trochus Montacuti** (Jeffreys).]

CXVII., dead.

CAPULIDAE.

Capulus hungaricus (L.).

XC., one dead, and fragment.

CYPRAEIDAE.

Trivia europaea (Montagu).

[**Cypraea europaea** (Jeffreys).]

CXVII., dead.

NATICIDAE.

Natica (Lunatia) sordida (Philippi).

CXXI., one, dead and broken.

Natica (Lunatia) catena (Da Costa).

LXXXVIII., CXXXI., dead.

Natica (Lunatia) Alderi (Forbes).

CXVII., dead; A II., one young; off Fastnet, 180 fath., two dead; A II. (19/5/04), one and four dead.

Natica (sp.).

CXXXII., very dead, probably *N. Alderi.*

SCALIDAE.

Scala clathratula (Adams).

[Var. **spinosa** (Jeffreys).]

A II., one.

TURRITELLIDAE.

Turritella communis (Lamarck).

[**Turritella terebra** (Jeffreys).]

LXXIII., two.

APORRHAIDAE.

Aporrhais pes-pelicani (L.).

LXXIII., LXXIV., LXXXV., dead; CXIV., one; 50 mi. W.N.W. of Cleggan Head, 17/8/'03, two.

Aporrhais serresianus (Michaud).

CXXXI., dead; CXXXII., several; A IV., one; 20 mi. W.N.W. of Black Rock, Co. Mayo, one; Fastnet (as below), two dead; A II. (19/5/'04), four dead.

CASSIDIDAE.

Cassidaria rugosa (L.).

[Cassidaria tyrrhena (Lamarck).]

CXXI., one fragment, of the earlier whorls only. Some perfect shells, inhabited by Hermits, and one or two living specimens were taken not far from this ground at 220 fath., in 1890, by the R. D. S. Survey. Two living examples have been taken by the *Helga* in May of the present year at 180 fath., 75 mi. S.W. by W., ½ W. of the Fastnet, Co. Cork, and another at 115 fath., 50 mi. W.N.W. of Cleggan Head. Mr. W. S. Green kept the specimens from the Fastnet ground under observation, and notes that they appeared quite unable to lay hold of the glass vessel in which they were placed. The foot was continually protruded, its inferior surface rolled up in the form of a funnel, as if the animal were trying to obtain a purchase on the soft ground from which it was trawled.

BUCCINIDAE.

Buccinum undatum (L.).

XC., CXXXI., one dead, with hermit; CXXXIII., one dead; off Valencia, 100 fath., two and one dead; A II. (19/5/'04), one dead.

Liomesus Dalei (J. Sow.).

[Buccinopsis Dalei (Jeffreys).]

LXXIII., dead; LXXXVIII.; CXXI., dead; CXXXI.; CXXXIII.; 75 mi. S.W. by W. ½ W. of the Fastnet, eight dead; A II. (19/5/'04), one dead.

This rather scarce species proved to be somewhat abundant in the deeper dredgings.

Neptunea despecta (L.).

[Fusus despectus (Jeffreys).]

LXXXVIII., CXXIX., CXXXI., single specimens, all dead and broken; LXXVII., fragment?

Neptunea antiqua (L.).

[Fusus antiquus (Jeffreys).]

CXXXI., CXXXIII., dead; Fastnet (as above), one.

Tritonofusus gracilis (Da Costa).

[Fusus gracilis (Jeffreys).]

LXXXVIII., dead; XC. two (dead?).

Tritonofusus (Siphonorbis) propinquus (Alder).

[**Fusus propinquus** (Jeffreys).]

LXXIII. ; LXXVIII., several dead ; LXXXVIII. ; XC., one dead, with hermit ; CXXI. dead, and in poor condition ; CXXIX., fresh ; CXXXI., fresh ; CXXXIII., dead ; A I., one and one dead ; A II. (19/5/'04), one dead ; A IV., one ; Fastnet (as above), one and four dead.

I must confess to being unable to appreciate the subgeneric distinction of these last two species ; indeed it is by no means easy to distinguish which species some forms belong to.

Tritonofusus jeffreysianus (Fischer).

[**Fusus buccinatus** (Jeffreys).]

CXXIX., fresh.

Tritonofusus fusiformis (Brod.).

[**Fusus fenestratus** (Jeffreys).]

LXXIII. ; LXXXV., dead and broken ; XC., CXXI., dead ; CXXXI., several dead ; Fastnet (as above), one dead.

A fine series of this rare species, frequently taken with *Liomesus Dalei*.

Tritonofusus (sp.).

LXXXV., two specimens, not in good enough condition for identification.

FASCIOLARIIDAE.

Buccinofusus berniciensis (King.)

LXXVIII. ; XC., one dead ; CXXI., two specimens, dead, one of a large and coarsely sculptured form, with *Anomia* inside ; Fastnet (as above), three and four dead.

OPISTHOBRANCHIA.

SCAPHANDRIDAE.

Scaphander lignarius (L.).

LXXXVIII., dead ; CXIV., one fresh ; CXXI., one fresh ; A II., one young ; same locality, 17/8/'03, three young ; off the Skelligs 50 fath., 6/3/'03, one ; Fastnet (as above), four ; off Valencia, 100 fath. one dead ; A II. (19/5/'04), one.

Bullinella cylindracea (Pennant).

[**Cylichna cylindracea** (Jeffreys).]

XC., dead.

BULLIDAE.

Roxania utriculus (Brocchi).

[Bulla utriculus (Jeffreys).]

CXXXII., one, broken.

PHILINIDAE.

Philine scabra (Müll).

A II., one, and eight young, probably of this species; 50 mi. W.N.W. of Tearaght, *ca.* 300 fath., one.

LIMACINIDAE, &c.

Consideration of the Pteropods is for the present reserved, as these pelagic forms can be more conveniently considered together, without regard to the depth of water over which they were taken. The materials for tabulation are not yet complete.

CEPHALOPODA.

See the separate paper by Mr. W. E. Hoyle, p. 93.

BRACHIOPODA.

CRANIIDAE.

Crania anomala (Müll).

LXXXV., fresh; LXXXVIII., living and dead; CXIV., fresh; CXVII., dead.

Terebratulina caput-serpentis (L.).

LXXXVIII., CXVII.

II.—ON SPECIMENS OF TRACHELOTEUTHIS AND CIRROTEUTHIS FROM DEEP WATER OFF THE WEST COAST OF IRELAND.

BY

W. E. HOYLE.

PLATE XIV. FIGS. 1 to 5.

Tracheloteuthis Riisei, Steenstrup.

Tracheloteuthis Riisei, Steenstrup, '81.
Tracheloteuthis Behnii, Steenstrup, '81.
Tracheloteuthis riisei, Hoyle, '86, p. 164.
Tracheloteuthis Behnii, Weiss, '88, p. 85, pl. 10, figs. 1—4.
Tracheloteuthis riisei, Fowler, '97, p. 525.
Tracheloteuthis Riisei, Carus, '90, p. 447.
Tracheloteuthis Behni, Carus, '90, p. 448.
Verrilliola nympha, Pfeffer, '84, p. 23, fig. 29.
Verrilliola gracilis, Pfeffer, '84, p. 22, fig. 28.
Tracheloteuthis Riisei, Steenstrup, '98, p. 112.
Tracheloteuthis Behnii, Steenstrup, '98, p. 113.
Tracheloteuthis riisei, Pfeffer, :00, p. 175.
Tracheloteuthis behni, Hoyle, :'02, p. 20; '03, p. 279, 281, 305.

The above list contains, it is believed, references to all the published literature on this genus, for *Tracheloteuthis guernei*, Joubin, has recently been referred by its original describer (:01, p. 45), and by Pfeffer (:00, p. 176) to the genus *Ommastrephes*, and need not therefore be further considered here.

The specimen which forms the basis of the following notes was sent me by my friend, Mr. E. R. Sykes, for determination. He had received it from Mr. E. W. L. Holt, along with other mollusca, collected by the Department of Agriculture. It appears as No. 1 in the following pages. It was obviously referable to the genus *Tracheloteuthis*, and at the first inspection I supposed it to belong to Steenstrup's species, *T. behni*, and under this name it was recorded in the Conchological Society's "List of British Marine Mollusca," just then going to press. Further investigation, however, showed that the specific determination was not quite so simple a matter as I had at first supposed. Fowler ('97) has recorded the occurrence of an example which combined in a curious manner the diagnostic characters of *T. riisei* and *T. behni*, and hence it was of importance to make a critical study of the points by which these two species were distinguished. I therefore appealed to my colleagues in the Copenhagen Museum to lend me some examples of the genus for investigation, and in due course received half a dozen specimens. None of these bore any names, and it was therefore not absolutely certain which Steenstrup had regarded as typical of either form. I appealed once again to the authorities at Copenhagen, placing my difficulty before them, and received the following reply from Dr. Jensen:—

"I am sorry to say we cannot solve the difficulty because we have no specimens of *Tracheloteuthis* which are named by Steenstrup. The specimens sent to you are the originals of Steenstrup, and have not been touched since his death."

The whole material at my disposal for comparison was therefore as follows:—

A.—SPECIMENS.

No. 1.—"Irish" Specimen, VI., 29–VI.–01, surface tow-net, 9.37 to 9.50 p.m., 90 miles true W. of Slyne Head, Co. Galway, 175 fathoms.

,, 7.—Copenhagen Museum.		Lat. 34° 40′ S., long. 7° W.
,, 8. ,,	,,	Indian Ocean, Salmin, 1868.
,, 9. ,,	,,	[No locality.]
,, 10. ,,	,,	West Coast of New Guinea; in the tube was a label, "328."
,, 11. ,,	,,	Lat. 34° 40′ S., long. 27° E., Andrea, 1870.
,, 12. ,,	,,	Lat. 60° 22′ N., long. 2° 6′ E., 7/12/68, Bang.
,, 15.—My own collection.		Messina.
,, 16. ,,	,,	,,

B.—PUBLISHED DESCRIPTIONS.

K. "Knight Errant" specimen, Hoyle ('86), p. 164, pl. 28, figs. 6–12.
W. Specimen from Messina, Weiss ('88), p. 85, pl. 10, figs. 1–4.
R. "Research" specimen, Fowler ('97), p. 525.

The numbers and letters are the abbreviations by which the specimens are referred to in the following tables. The numbers are those of my own register of specimens examined.

My first care was to measure all the specimens as carefully as possible without injuring them. This was by no means an easy matter, for several of them were very stiff from having been kept in strong alcohol, and were shrunken and distorted. The results are contained in the subjoined table, where are also included the measurements previously published.

TABLE I.

Measurements of Specimens of Tracheloteuthis.

The dimensions are given in millimetres, and the lengths of the arms are measured from the centre of the eye.

—	No. 1.	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.	No. 12.	No. 15.	No. 16.	K.	W.	R.
Mantle, length, ...	25	26·5	19	17	20	25	12	31	33	32	27	23
,, breadth, ...	7	-	6	4·5	6	7	5	7	6	8	7·8*	9
Fin, length, ...	9	10	5	3	3	10	4	14	15	13	6	8
,, breadth, ...	12·5	12·5	8	5	5	14	6	17	17	19	8	13
Arm 1, length, ...	5	8	5	3	5	8	4	9	12	8	3·2	5
,, 2, ,, ...	14	21	18	7	12	18	8	20	23	18	7·5	13
,, 3, ,, ...	12	18	15	5	9	15	6	16	20	15	6	11
,, 4, ,, ...	8	15	10	4	8	12	5·5	12	17	13	4	8
Tentacle, ,, ...	23	30	29	13	22	27	15	28	26	32	13·5	21

* Supplied from the drawing.

Steenstrup's diagnostic characters are as follows:—

—	T. Riisei.	T. Behni.
Fin, shape,	Rhomboid,	Cordate.
„ length,	$\frac{1}{3}$ of mantle,	$\frac{1}{2}$ of mantle.
Ventral arm, length,	$\frac{2}{3}$ of second arm,	$\frac{1}{2}$ of second arm.

The first character seems to me of little value. The difference between a rhomb with rounded angles and a broad cordiform figure is not very conspicuous under any circumstances, and in addition the fins are commonly so twisted and folded that it is almost impossible to ascertain accurately their original outline; hence a very slight error will make all the difference between rhomboid and cordate.

The other distinctions are matters of measurement, and therefore less liable to misconception. To allow of easier comparison, I give a table in which the critical ones are expressed as percentage ratios; the length of the fin being given as a percentage of that of the mantle, and the lengths of the arms as percentages of that of the second pair.

TABLE II.

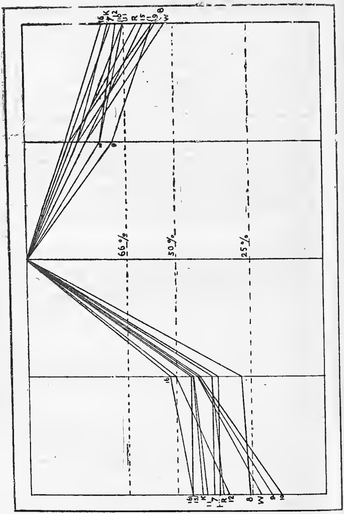
SHOWING the ratios of the length of the Fin to that of the Mantle, and of the lengths of the arms to that of the second arm.

—	No. 1.	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.	No. 12.	No. 15.	No. 16.	K.	W.	R.
Mantle, length, ...	100	100	100	100	100	100	100	100	100	100	100	100
Fin, length, ...	36	38	26	18	15	40	33	45	45	41	22	35
Arm 1, length, ...	36	38	28	43	42	44	50	45	52	44	43	38
„ 2, „ ...	100	100	100	100	100	100	100	100	100	100	100	100
„ 3, „ ...	86	86	83	71	75	83	75	80	87	83	80	85
„ 4, „ ...	57	71	56	57	67	67	69	60	74	72	53	62
By fin-mantle ratio,	B	R	B	B	B	R	R	R	R	R	B	B
By arm ratio, ...	B	R	B	B	R	R	R	B	R	B	B	R

This table is reproduced in graphic form in the diagram below.

The letters at the foot of each column indicate to which species the specimen would be referred if the fin-mantle ratio or the arm-ratio were taken as the standard.

Specimen No. 7 has had the mantle split down the middle line below, and agrees well with Steenstrup's figure, so that it may fairly be regarded as the type of that species. Three specimens (Nos. 8, 9, 10) have the fin-mantle ratio given by Steenstrup for *T. behni*, and since in the two former the arm-length ratio also agrees with that given for this species, it is therefore allowable to regard them as being the types of that species—the more so as the only one of which the origin is known is from the Indian Ocean, the habitat assigned by Steenstrup to the species.



It will be seen that in several instances the same specimen would be placed in one species by the former criterion and in another by the latter. This is sufficient to throw grave doubt upon the efficacy of such features as diagnostic characters.

With respect to the value of the fin-mantle ratio as a specific character, a special difficulty arises, namely, that it is not constant in the same

animal at different ages. I have elsewhere ('86, p. 156) shown reason to believe that in the squids, at all events, the hinder portion of the body, along with the fin, grows more rapidly than the anterior, and therefore that the fin-mantle ratio increases with the growth of the animal.

If we arrange the specimens of *Tracheloteuthis* now under discussion in the order of their fin-mantle ratios, and place side by side the mantle-length of each, we shall see that this is, on the whole, fairly borne out, and that the longest specimens have the largest ratio.

TABLE III.

SHOWING the specimens arranged in order of the fin-mantle ratio, and giving the actual length of the mantle and the percentage ratio of the former to the latter for comparison.

Number.	Fin to Mantle.	Length of Mantle.	Percentage.
10	15	20	75
9	18	17	106*
W.	22	27	81·5
8	26	19	137
12	33	12	275*
R.	35	23	152
1	36	25	144
7	38	26·5	149
11	40	25	160
K.	41	32	128
15	45	31	145
16	45	33	138

* The mantle is so shrunken and distorted that the measurements are uncertain.

Such being the case, it seems fair to suppose that those specimens from Copenhagen which have a small fin-mantle ratio (Nos. 8, 9, 10), and which are therefore presumably the types of *T. behni*, have this character simply because they are young specimens, and not because they belong to a different species.

With respect to the lengths of the arms, I have no accurate information as to how their relation is affected by growth, but a study of Table II., or a glance at the diagram where they are graphically summarised, will show that their ratios are subject to small variations which cannot possibly be regarded as of specific significance. This is well seen in the case of Specimens 15 and 16, which are both from Messina, and clearly referable to the same species, and yet exhibit considerable differences in the relative lengths of the arms.

I, therefore, conclude that there is no sufficient reason for separating these two species of *Tracheloteuthis*. As regards the specific name which the form should bear, the only mode of applying the rule of priority seems to be to take the name which stands first in the original description, *T. riisei*. This is further a satisfactory solution inasmuch as the forms which received this name from Steenstrup are the largest, and therefore represent most nearly the adult condition of the animal.

The specimen received from Mr. Sykes being the first that has been recorded from the British area as defined by the Conchological Society, I have thought it well to give a figure of it (pl. XIV., fig. 1), as well as magnified drawings of the tentacular club (pl. XIV., fig. 2), of one of the larger tentacular suckers (pl. XIV., fig. 5), and of one of the suckers of the arms (pl. XIV., figs. 3, 4).

I experienced considerable difficulty in making out the form of the ring of the large tentacular sucker. So far as I could ascertain, the ring is smooth, but there are a number of papillæ on the margin of the sucker

which, if turned inwards, produce the appearance of teeth. These minute suckers are, however, not at all easy to examine and draw with accuracy.

Cirroteuthis sp.

A well-preserved young specimen of this genus was sent me by Mr. Holt for examination on July 7, 1903. It measures only about 1·5 cm. in length, and it will, I fear, be impossible to say to what species it belongs; but it is of interest as being the first recorded occurrence of the genus in what may be called the British area.

Locality.—" 77 miles west of Achill Head, Station CXX., 24–8–01; townet on trawl beam, 382 fathoms." [H. 193.]

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EXPLANATION OF PLATE XIV.

FIGS. 1 TO 5. **Tracheloteuthis Riisei,** Steenstrup.

Fig. 1.—Ventral view of the specimen taken off Slyne Head; × nearly 3 diameters.

Fig. 2.—Club of the left tentacle; ×10.

Fig. 3.—Side view of a sucker from one of the arms; ×55.

Fig. 4.—Front view of a similar sucker; ×55.

Fig. 5.—Front view of one of the large tentacular suckers; a portion of the tesselated area surrounding the horny ring is shown in the upper right-hand part of the rim; ×15.

Fig. 6. *Ianthina rotundata* (Leach).

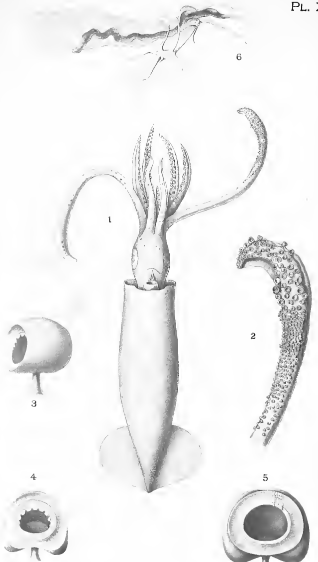
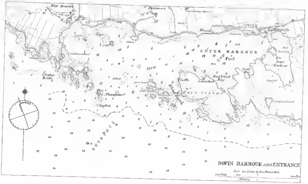


Fig. 6, M. F. W., caet. W. E. Hoyle del.

Figs. 1–5. Tracheloteuthis Riisei.
Fig. 6. Ianthina rotundata.

BALLYNAKILL HARBOUR
Soundings in FATHOMS
Sea Mile
N ENTRANCE
S ENTRANCE
S PASSAGE
Lettermore
Ardagh
DERRYINVER BAY
Dawros-more
Ardkyle
Ross
Derrylahan
FAHY BAY
Knocknahaw
Dawrosbeg
BARNADERG BAY
Cluindarowen
Roscreagh


West Quarter
OUTER HARBOUR
Pool
Inner Harbour
East Bay
Port Island Bay
Castle
Port Island
Cromwell Rocks
Pound
Dog Fish
ENTRANCE
BOFIN HARBOUR AND ENTRANCE

APPENDIX, No. IV.

i.—Schizopodous Crustacea from the North-East Atlantic Slope, by E. W. L. HOLT and W. M. TATTERSALL, B.Sc.

ii.—Note on a Genus of Euphausid Crustacea, by W. T. CALMAN, D.Sc.

i.—SCHIZOPODOUS CRUSTACEA FROM THE NORTH-EAST ATLANTIC SLOPE.

BY

E. W. L. HOLT AND W. M. TATTERSALL, B.Sc.

PLATES XV. TO XXV.

INTRODUCTORY.

We intend by the above title no dissent from the views of Hansen, 1893, and Calman, 1904, of the taxonomic position of the forms which, previous to the pronouncements of these authorities, had been regarded as forming a natural group. The old term has its convenience, not only for brevity of title, but because it goes near to expressing, for the higher crustacea, a bionomic unit, which needs only the Sergestids and certain amphipods to complete it.

Our material consists of collections made (1) by the *Oceana* (Mr. George Murray and Mr. V. H. Blackman) in November, 1898, in deep water west of the southern part of Ireland, at depths reaching to nearly 1,800 fathoms; (2) by Dr. G. H. Fowler in H.M.S. *Research* in July, 1900, off the north part of the Bay of Biscay at depths reaching 2,341 fathoms; (3) by the Department's fishery cruiser *Helga* along the west coast of Ireland at depths between 50 and 1,000 fathoms, at all seasons of the year, but chiefly in the summer months; (4) by the fishing boat *Monica* on and about the mackerel grounds outside the Bofin archipelago, Counties Galway and Mayo, in spring, summer, and autumn since 1900.

The *Monica's* operations barely touch the crest of the slope, which we take as commencing, for the purposes of these notes, at the fifty fathom line, and we shall only notice so much of her catch as consists of organisms obviously belonging rather to the slope than to the littoral area, or as much to each.

The fishing implements by which the various collections were made were of diverse order. The *Oceana* and *Research*, being interested solely in Plankton, never touched bottom with their nets. The former used ordinary open tow-nets, fished horizontally at known depths (as far as such may be with certainty computed) and hauled, still fishing, to the surface. The *Research* used a vertical net, opened and closed by messengers at known depths, and for surface work horizontal open nets. The *Helga* used a horizontal net, opened and closed by messengers, but it contributed nothing to our material. Her efficient nets were ordinary open tow-nets of various shapes and sizes, and, especially, nets and bags of fine material fastened to the "back" of a beam-trawl. These nets, if placed at the point where the swirl from the apex of the ground rope rises through the meshes of the "back," are certain traps for small bottom organisms which may lie in the path of the trawl. A moderate amount of sand in the net will indicate, in experiment, what seems to be the most

favourable position. Placed too far back, the nets get too much sand and often burst. With regard to the open tow-nets used by the *Helga*, it must be understood that in addition to fishing at the depth indicated in the record, the nets were also fishing during their descent and ascent. It does not, therefore, follow that the whole contents of a tow-net came from the depth to which the tow-net was lowered. Indeed, in May and August, 1904, when these open tow-nets were especially successful in their endeavours to capture the actively swimming Euphausians, there is evidence that a considerable portion of the catch was obtained during the ascent of the net.*

The *Monica* used ordinary tow-nets, mostly fished while she was drifting to her mackerel nets, and a larger tow-net of strong mosquito gauze, towed under sail to and often beyond the bursting strain; but we must confess that our attempts to catch the large active Euphausians, known from the evidence of fish-stomachs to be abundant in the neighbourhood, have not met with much success under sail-power in shallow water.

We divide our notes into two parts, of which the first contains the descriptions of new genera and species and other systematic matter, while the second gives a full list of the species taken, with localities of capture, and a brief note of their distribution. Full particulars of the vertical distribution of the material taken by the *Oceana* and *Research* are, at the request of the collectors, reserved for publication in the Annals and Magazine of Natural History and the Transactions of the Linnaean Society respectively, other items of the collections having already been dealt with in those media.

A list of authorities quoted will be found at the end of our notes. We have not thought it necessary to burden the text with reference to original records of distribution when these have been sufficiently summarised in more general papers of later date.

Part I.

SYSTEMATIC NOTES, WITH DIAGNOSES OF NEW GENERA AND SPECIES.

Everyone who has occasion to deal with material from a little explored district must encounter the same difficulty as ourselves. Existing genera will be found to have been framed to conveniently subdivide the species met with in areas already well observed, and the question will arise, in the tabulation of the results of the first searchings of virgin ground, whether it is better to expand old genera for the reception of new species, or to erect for them new genera. The answer must rest, we believe, on a reasonable appreciation of the finality of the results obtained; for if the exploration be considered to approximate to thoroughness, the expansion of genera to their fullest apparently natural capacity would seem to be an obvious duty. If, however, the region (using the term in its widest sense) has been only in the most imperfect fashion reconnoitred, the provisional expansion of a genus, with certainty of incessant future tinkering, may be deemed to amount to a crime.

In the case with which we have now to deal the majority of the species which we are compelled to inflict upon the list were obtained in a few hauls by fine-mesh nets on the back of a beam-trawl. It is a commonplace that deep-water organisms are largely cosmopolitan, certainly in so far as may concern their generic characters, though species may prove to maintain the horizontal limits of distribution which have been assigned to them. Consequently, if the use of a new method of collecting in the deep water of one particular geographical area, in a few hauls

* The *Helga* gatherings from deep water in August and November, 1904, have not yet been completely worked out, but a few additions from them have been made to the records in this paper in press.

only, has resulted in the discovery of undescribed forms, it may be taken as certain that the extension of this method or the employment of improved apparatus on the same and on other parts of the sea-floor must inevitably result in the recognition of many other kindred organisms. For this reason, though most of our new material could be accommodated by modification of the existing genera of the Erythrops group, we have decided to abstain from meddling with the diagnoses of such genera. A genus, discarded, as ours inevitably must be, when something like a complete account of the fauna permits a re-arrangement of species, passes out of knowledge and injures nobody; or will, at least, cease to be harmful whenever the fashion of reviving deservedly forgotten names has run its due course.

TERMINOLOGY.

At the suggestion of Dr. Calman, to whom we are greatly indebted for assistance in the preparation of this part of our paper, we have discarded the term "maxillipede," and call the anterior thoracic appendage the "first thoracic limb" and its endopodite the "first leg," and so on. The anterior limbs are not, in the Euphausians and Mysids, at all sharply defined in structure from the succeeding, and the existence of a single maxillipede, when class-room memories of the cray-fish call for three, is a nuisance.

Sars in retaining the term "maxillipede" for one pair of appendages (1885), has followed Milne-Edwards in considering that pair as belonging to the cephalon rather than the thorax, but though in Amphipods and Isopods this appendage appears to be part of the "head," it is nevertheless morphologically thoracic.

PHYLOGENY.

In *Hypererythrops serriventer* and *Euchaetomera Fowleri* (see pp. 121, 124) the bases of the thoracic limbs bear a well-developed digitiform process (see Pl. XXIII., fig 8). This is clearly an epipodite, presumably a rudimentary gill, and, as Dr. Calman reminds us, furnishes additional evidence of the affinity of the *Mysidae* and *Lophogastridae*. In a less pronounced form an epipodite is present in other of the *Leptomysinae*, as may be seen from Sars' figure (Monog. Mysid. Pl. II., fig. 4) of the under side of an *Erythrops*, but no attention appears to have been hitherto directed to the fact.

Norman has divided into sub-families the genera of Mysidae which were known as British in 1892. In continuation we have very briefly defined such new sub-families as are required for the reception of new material.

DIVISION.—**EUCARIDA.**—Calman, 1904.

ORDER EUPHAUSIACEA.

FAM. EUPHAUSIIDAE.

SUB-FAM. nov. *EUPHAUSINAE.*

Eyes not or only slightly bilobate. None of the legs much longer than their immediate fellows, nor terminating in brushes or claws. Palps of maxillae simple.

GENUS **Euphausia**, Dana.

Euphausia pellucida, Dana (1852).

Euphausia pellucida, Sars.—1885.

Thysanopoda bidentata, Sars.—1882.

Representatives of the species found in the N.E. Atlantic seem to invariably have the pectinations of the antennular comb much more numerous than in the examples figured by Sars in his Challenger Monograph, while the preanal spine is very often simple, even in adults.

One of the *Research* specimens, measuring 26 mm. from tip of rostrum to the end of caudal fan, is the largest of which we have seen a record.

Several females (*Research*, July) were found carrying ova loose among the thoracic legs, which, with their setae, form a sort of basket. Calman (1904) surmises that the nursing period is very brief, and this is borne out by the number of ova and very early larvae, apparently belonging to this species, which we found in the *Research* collection.

Locality and Distribution, see p. 133.

Euphausia Lanei,* sp. n.

PLATE XXIV., Figs. 6-9.

It is necessary to refer a small *Euphausia* to a new species, apparently very closely allied to *E. splendens*, but, in so far as it is possible to institute comparisons between a single probably young specimen and a species described from adult examples, distinguishable by the following minor points.

Body generally slender, more so than in *E. pellucida* of same size. *Carapace*, with one lateral denticle, drawn out in front into a small obtuse rostrum, which only reaches one quarter the length of the eyes. The eye-lobes of the carapace are more pronounced and acute than in *E. splendens*. Posterior margin of carapace not so deeply emarginate as in *E. splendens*. *Eyes* as in *E. splendens*. *Antennular peduncle* longer and somewhat slenderer than in *E. splendens*. Basal joint the longest, equal in length to the other two, outer distal corner produced into an acute process which is absent (at least in adults) in *E. splendens*. Digitate leaflet absent. A fascicule of strong setae is present (see fig. 6), the setae more numerous than in *E. splendens*. The distal joint is produced dorsally between the flagella in a pointed process. *Antennal peduncle* much as in *E. splendens*. *Antennal scale* reaching just a little past the second joint of the antennular peduncle, and somewhat narrower than in *E. splendens*, less broadly truncate at tip, and terminated on its outer edge by a spine which is much more pronounced than in *E. splendens*. Basal spine of scale small, less than one-third the length of scale. *Pleon* narrower than carapace, last segment once and two-thirds as long as preceding one. *Preanal* spine simple. *Telson* and *uropods* of same form and relative lengths as in *E. splendens*. Sub-apical spines of telson as in *E. splendens* and *E. similis*. Length, 10 mm.

Locality, see p. 134.

GENUS Thysanopoda. M.-Ed.

Thysanopoda acutifrons, sp. n.

This form having come to hand after our notes had gone to press, we can only give a preliminary diagnosis, viz:—

All characters almost exactly as in *T. obtusifrons*, G. O. Sars, except—

Rostrum broadly triangular, its extremity acute, not extending beyond the eyes, its sides slightly inflated. *Telson* with four pairs of denticles in addition to the large subapical spines, the posterior being immediately above the subapical spines, the anterior about midway between the subapical spines and the origin of the telson. There is no trace of the parallel serrated ridges exhibited by *T. obtusifrons*. The apex of the telson is suddenly constricted and terminates in a slender spinous process. *Preanal spine* well developed and simple. *Colouration* variable; all specimens adorned with much red pigment, some with antennules, antennae, carapace, pleon and caudal fan more or less completely covered

*D. H. Lane.

with olive-brown chromatophores. *Length* from 9 to 22 mm., the smallest specimen having the antennular peduncle imperfectly developed.

This is probably a small species in comparison with its congeners. It belongs to the section of the genus which is characterised by the absence of a spine on the side of the carapace. Ortmann (1893) considers that Sars overlooked the presence in *T. obtusifrons* of a small spine on the side of the carapace. *T. acutifrons* certainly has none. In the character of the preanal spine it agrees with the forms referred by Ortmann to *T. obtusifrons*.

Except in regard to the rostrum our species would seem to be very closely allied to *T. pectinata*, Ortmann, in so far as the characters of the latter have been defined.

Locality, see p. 134.

Genus **Nyctiphanes**, G. O. Sars, 1883.

From Sars' remarks in his preliminary notice of the Challenger Schizopoda, it is clear that he founded this genus upon *Nyctiphanes australis*, though he considered his definition wide enough to include the forms then known as *Thysanopoda norvegica* and *T. Couchi*. With the latter, even at the time of issue of the Challenger Report, he had obviously no acquaintance, since he expressed a doubt as to its distinctness from *N. norvegica*.

There is between *N. norvegica* and the two other species a constant difference which we consider to be of generic rank, and we have therefore referred the former to a new genus for which we propose the name *Meganyctiphanes*.

Taking Sars' diagnosis as a basis, the two genera may be easily recognised by the following characters.

Nyctiphanes, G. O. Sars.

Sixth and seventh thoracic limbs in the female without an exopodite. Antennular peduncle considerably stouter in the adult male than in the female.

Genus **Meganyctiphanes**, n.

Sixth and seventh thoracic limbs with an exopodite in both sexes. Antennular peduncle scarcely, if at all, stouter in the adult male than in the female.

The important difference is in the absence, in the females of *Nyctiphanes*, of the exopodite of the sixth and seventh limbs. Both the known species, *N. Couchi* and *N. australis*, carry their ova in paired pyriform masses, closely apposed to the bases of these limbs. In the only known species of *Meganyctiphanes*, a most abundant and well-known form, ovigerous females have never been observed, and it seems probable that the differences of exopodites in the females of the two genera are associated with differences of nursing. If the female *M. norvegica* carried her ova as in *Nyctiphanes* her exopodites would be useless and greatly in the way. We suspect that she either nurses them for a brief period in the basket formed by her thoracic limbs and their setae, as is the case with *Euphausia pellucida*, or does not nurse them at all.

For practical purposes the three species, which alone possess the reflexed leaflet at the end of the first joint of the antennular peduncle, may be easily distinguished by the following characters:—

A. A spine above the origin of telson. — *N. Couchi.*

B. No spine above the origin of telson.
- i. No denticulation of the lateral edge of the carapace. — *N. australis.*
- ii. Lateral edge of carapace with a denticulation at about the middle of its length. — *M. norvegica.*

Nyctiphanes Couchi (Bell).

PLATE XVII.

The only obvious character in which this species differs from *N. australis*, Sars, is in the spine above the telson, which is an acumination of the posterior margin of the shell of the last segment of the pleon, is already well developed at the earliest stage at which generic recognition is possible, and persists throughout life. At no stage of *N. australis*, *vide* the descriptions and figures of Sars, is such an acumination present, nor, as we are entitled to state from the examination of ample material, in *M. norvegica*. Norman gives the length of the species as 15 mm., but it actually reaches at least 17 mm. from tip of rostrum to extremity of telson, and the examination of full-grown specimens permits us to add something to previous knowledge of the species.

Bell's well-known figure represents an ovigerous female, with two pyriform egg-masses depending from her postero-thoracic region by their narrow ends. We have taken a number of ovigerous females, of which Miss Woodward has depicted one, and though the egg masses are paired and pyriform, it is their broad and not their narrow ends which are apposed to the body of the parent, the condition being in fact exactly as in Sars' figures of *N. australis*, though we have not always found the egg-masses of the same size on each side, nor tapering distally to the same extent. They are easily detached, and it seems not impossible that Bell's artist may have dislodged the ova from the parent and, in his attempted restoration of the original condition, drawn them upside-down and separate. In some specimens, however, taken after our figure had been prepared, the egg-masses are much larger and of more uniform diameter throughout, though the basal portion is still the thicker. In one in which the posterior limbs have been widely separate from their fellows, *in articulo mortis*, the egg-masses are far apart distally, but are still quite unlike the condition figured by Bell.

In all full-grown females taken in the spring and summer months (we have none from gatherings at other seasons, except macerated specimens from the stomachs of sea trout) we find the ultimate and penultimate thoracic limbs widely separate, the sex being thus visible at a glance. In some we can find a trace of the glutinous membrane which once contained the spawn, and though this cannot be detected in others we suspect that the separation of the limbs has been in all cases caused by the mechanical pressure of an intervening egg-mass and not by a developmental disturbance of the topographical anatomy.

Norman gives, *as a character of the male*, the presence of a comb-like process at the end of the second joint of the antennular peduncle. Opportunity of examining sufficient material at all stages shows that this is not distinctive of males. It is present in small males, but disappears in large specimens of that sex, whereas in the female it persists to the end of life. In regard to this character we have critically examined over fifty specimens, and the cursory examination of many hundreds for purposes of specific identification has given us no indication that our conclusions, which follow, may be incorrect.

Specimens measuring less than 12 mm., tip of antennular peduncles to tip of telson, have usually no sign of a comb. At a length of 12 mm., the comb begins to make its appearance in either sex, being present in its simplest form as a mere spine-like prolongation of the inner dorsal angle of the distal end of the second segment of the peduncle. This prolongation is somewhat upwardly directed. In further development the prolongation becomes considerably enhanced, and its outer edge becomes inflated, upwardly rotated, and thrown into a slightly backwardly-directed fold at its base, assuming meanwhile a varying number of pectinations of irregular size. The inner faces of the prolongation of each peduncle are closely apposed and their upper parts are at a level slightly above that of the third segment.

Subject to the above general statement as to size of individual, there does not appear to be an exact constancy as to the degree of development of the comb in relation to the total length of the individual, nor have we reason to suppose that successive ecdyses are accompanied by precisely progressive degrees of pectination of the comb. The latter may be fully developed in a male of 12 mm., tip of rostrum to tip of telson, as in the specimen shown in fig. 1, or may still be imperfect. In males of 16 mm. or more, measured from tip of rostrum, there is no comb, and at the most the previously pectinate edge of the integument of the second segment may show a slight arcuation, whereas in females the comb persists to the maximum size attained.

While losing the comb, the antennular peduncle of the large male becomes distinctly larger than that of the female—*e.g.*, in specimens of the two sexes having the same total length of 17 mm., from tip of rostrum, the peduncles have the following measurements:—

	Male.	Female.
Length of second segment,	1·02	·90 mm.
Width ,, ,, ,,	·42	·30 ,,
Length ,, third ,,	·60	·48 ,,
Width ,, ,, ,,	·42	·24 ,,

In the male the third segment bears at its origin near the inferior internal angle three closely-set spines, a little more than half as long as the segment, forwardly directed and somewhat inflexed, plumose except at the distal extremities. In several examples (male) spines have been observed on the internal ventral edge of the left peduncle, but they do not seem to be of universal occurrence. In both sexes the outer face of the second segment bears a small bunch of setae, and the brush of setae which arises externally to the origin of the flagella does not appear to differ materially in the sexes. In general the antennular differences of the sexes in large specimens are so nearly the same as that depicted by Sars for *N. australis* that his figures would serve for *N. Couchi*.

The copulatory apparatus of the male pleopods does not appear to be more fully developed in large specimens than in the 12 mm. example described by Holt and Beaumont, 1900. The ulterior development of the antennular peduncle is therefore, in all probability, not associated with the attainment of sexual potency. The smallest ovigerous female observed measures 10 mm. from tip of rostrum to the tip of telson; the largest, 16 mm. The largest specimens of the species we have observed measure 17 mm. from tip of rostrum to tip of telson. The size of the egg-mass seems to vary with the size of the parent. In one specimen the ovisac contained naupliid larvae. From the material at our disposal the breeding season would seem to reach its maximum sometime about May.

The mouth parts and thoracic appendages examined in detail call for no special remark in comparison with those of *N. australis*.

The pigment of the eyes is brownish-black. Other pigment is bright scarlet, and may probably be variable according to the degree of expansion of the chromatophores. It is conspicuously present about the mouth-parts and proximal joints of the thoracic limbs, and the luminous organs are brilliantly coloured.

Locality and Distribution, see p. 134.

Meganyctiphanes norvegica (M. Sars).

Thysanopoda norvegica, M. Sars.

Nyctiphanes norvegica, G. O. Sars *et auct.*

PLATE XVI.

Figures of this species have already been given by Watase (copied by Shipley and MacBride), Koelbel and Zimmer. It is a well-known form, and we figure it chiefly in explanation of the differences which separate it from *N. Couchi.*

M. norvegica is a much larger form, attaining at least 40 mm. from tip of rostrum. The carapace has the armature shown in figs. 2-4, whereas in both species of *Nyctiphanes* it is unarmed save for the rostrum.

We can detect in the largest examples examined no obvious difference of size in the antennular peduncles of the two sexes of *M. norvegica*, a condition in marked difference to that exhibited by *Nyctiphanes*. On the other hand the copulatory paraphernalia of the first pleopod of *Meganyctiphanes* are much more highly developed than those of *Nyctiphanes* (see Holt and Beaumont, 1900).

On account of the larger size, the rudimentary gill or epipodite of the first thoracic limb is more conspicuous in *Meganyctiphanes*, but it is about equally developed in *Nyctiphanes*.

Sars and S. I. Smith appear to be acquainted with the larvae, but have not to our knowledge described them. A fairly complete series (with which, as with other Euphausian larvae, we hope to deal fully in a later communication) enables us to say that at no period of growth is there a spine above the telson. As in other Euphausian larvae, the second segment of the antennular peduncle has a blade-like prolongation, but this disappears with other larval characters, and at no period of growth has *Meganyctiphanes* anything comparable to the antennular comb of *N. Couchi*.

The eyes are brownish-black. Other pigment is red—crimson or scarlet by reflected, orange-red by transmitted light—and, with a considerable allowance for variation in expansion and number of chromatophores, may be said to be distributed as follows:—The gastric and hepatic regions are red, and the course of the gut is picked out in red as far back as the end of the second segment of the pleon. There are chromatophores dorsally on the proximal third of the telson, on the last segment of the abdomen, and, in less number, on the fourth and fifth segments and at the origin of the first. The posterior angles of the epimera of all but the last segment are rather conspicuously pigmented. Pigment is present on the eye-stalks and antennular peduncles, in great quantity about the mouth parts, rather abundantly on the proximal joints of the first three thoracic legs, faintly on those of the remainder, very faintly on the basal parts of the first four pleopods. The luminous organs are crimson, purplish by transmitted light.

These notes of colouration were made in comparison with those given above for *N. Couchi* from specimens taken in the same haul. We thought at first that a constant difference of pigmentation could be established, but our conclusion, after the examination of much more material, is that, although *Meganyctiphanes* seems generally to have more red pigment, the two species are so variable in this respect that pigmentation cannot be safely employed for purposes of determination. In any case the red pigment disappears after a few days in alcohol or a few weeks in formol, and is not, for the usual circumstances of determination, of any importance.

Breeding.—Larvae were taken at the end of June, but since, as appears from the account of distribution, small specimens occur throughout the year, this does not definitely fix the breeding season to the immediately antecedent period. On the 10th May, 1904, Mr. Farran took a number of specimens up to 30 mm. in length at or near the surface at night, together with many large *N. Couchi*, of which the females were ovigerous. In the same gathering are a large number of loose ova, all which we have as yet examined being in a very early stage of development and resembling those of *N. Couchi* in size and appearance. Many of the *Meganyctiphanes* have a few of these ova in their leg-basket, but not in such number or so disassociated from obvious prey as to warrant the conclusion that they are the nurslings of their present possessors. That they are ova of *Meganyctiphanes* is, in spite of their relatively small size, not impossible, but their presence in the midst of prey suggests rather that this form has an indiscriminate appetite than that it takes any care of its progeny.

FOOD.—The examples mentioned above are the only ones in our possession which throw any light on the feeding habit. Many of them have the leg-basket more or less stuffed with prey, including copepods, schizopod or decapod larvae, fragments of *Spirialis*, and other matter which requires further examination. One has the tail of a larval fish, 16 mm. long, in its mouth.

Locality and Distribution, see p. 135.

SUB-FAM. nov. *NEMATOSCELINAE.*

Eyes more or less bilobate. Second or third legs elongate, with distal extremity forming a brush or claw.*

GENUS **Thysanoessa**, Brandt.

Thysanoessa longicaudata (Kröyer).

T. tenera, Sars.—1882.

T. longicaudata, Hansen.—1887.

T. longicaudata, Norman.—1892.

PL. XV.

Carapace with lateral margins entire; rostrum varying somewhat in length, but reaching beyond the middle of the first joint of the antennular peduncle, narrow, lanceolate, slightly keeled. *Antennal scale* reaching beyond the second joint of the antennular peduncle, but hardly beyond the middle of the third joint; apex more or less obliquely truncate. *Eyes* rather large, constriction well marked. *Second legs* having the two distal joints slightly greater in combined length than the preceding; the ultimate joint about half as long (if anything rather more than half as long) as the penultimate, narrow, of equal width throughout, with a tuft of setae at the extremity, and about four to six and five to seven setae on the dorsal and ventral edges respectively. *Pleon* with no distinct keels on the segments, the last equal to, or very slightly less than the combined length of the two preceding. For about 35 specimens which were measured the average length of the last segment compared with the length of the preceding two was as 10 to 11, its postero-dorsal margin entire or (very rarely) produced into an extremely minute acumination.† *Uropods* narrow, the inner longer than the outer, nearly reaching, or even slightly passing, the extremity of the telson (exclusive of lateral spines).

Hansen, 1887, has shown that Kröyer's types of *T. longicaudata* agree with the characters given by Sars for *T. tenera*. Our diagnosis of the few characters concerned aims at uniting in a single species individuals conforming exactly to *T. tenera*, and the forms known to us from more southern latitudes. It may be a question of race, but as Fowler's Faroe specimens seem much like those from the S.W. of Ireland, we do not know where, if anywhere, is to be found the line which, by divergence of characters, sharply separates northern from southern forms. Briefly, *T. tenera, sensu stricto*, has the antennal scale more oblique at the apex and in relation to the antennular peduncle somewhat shorter, the rostrum perhaps a little wider, the eyes a little larger, and the inner uropods, in

* For a key to the genera which we include in this sub-family, see Calman's paper, p. 153, *infra*.

† This affords no possibility of confusion with *T. neglecta*, in which the spine over the telson is always very strongly developed (*vide* Sars, 1882).

relation to the telson, rather distinctly longer than in examples from off the Irish coast. We do not think these differences would warrant us in separating the southern forms even by a varietal name.

Our figures, except that of the leg, were taken from *Oceana* material, and the lateral view shows the most perfect specimen in a large series. It actually has the bud of a second leg, which has been broken off at some previous period, and this is the only attempt at a leg in the whole collection. Had we not found in our own Irish collection one, and in Dr. Fowler's Faroe material several specimens similar in other respects, but still retaining their legs, it would have been impossible to definitely associate our *Oceana* material with *T. longicaudata*. The second legs alone do not furnish a satisfactory means of distinction between this species (which is only known to reach 12 mm.), and small examples of *T. neglecta*, Kr. (=*T. borealis*, G. O. Sars), which grows to 24 mm. While large *T. neglecta* have the ultimate distinctly less than half the length of the penultimate joint, examples comparable in size to *T. longicaudata* have the ultimate joint, in comparison with the latter species, but very slightly shorter, and there is no sufficiently constant difference in the number of setae to be of value.

Our drawings were made before perfect specimens were available, and we use them for publication because they convey the best idea of the species as it usually comes into the hands of the student. *T. longicaudata* is, more than any Schizopod which we know, liable to lose its legs in the net, and a perfect specimen with its bunch of legs looks so much deeper that one does not at first recognise its specific identity with the ordinary stripped example.

The eyes of Euphausians are very liable to lose their characteristic shape in the net, and the bilobate condition of the eye in *Thysanoessa* and allied genera is less marked in the young than in the adult,* while the gills and other characters of the thoracic appendages are, even when they escape destruction, not too tangible in material of small size. Consequently small, more or less bare, hulls of *Thysanoessa* and its allies (*except Stylocheiron*) often give more trouble in determination than is readily imagined.

We do not know anything about the breeding of *Thysanoessa*. Its close structural affinity suggests, but by no means proves, that the ova are carried in the same way as in *Stylocheiron*.

Locality and distribution, see p. 138.

Thysanoessa gregaria, G. O. Sars, 1885.

Some small examples of *Thysanoessa*, ranging in length from about 7 to about 9 mm., appear to be referable to this species, though exhibiting certain characters which do not exactly harmonise with Sars' diagnosis. The average length of adult females is stated to be 18 mm., males being somewhat smaller, and some, perhaps all, the peculiarities which we have noted, may well be youthful characters.

Some of the specimens are fairly perfect, and it must be understood that in characters which we do not mention below we have failed to detect any divergence from the type.

The segments of the pleon are described as quite smooth above. In our examples the fourth and fifth segments show a very slight depression in the dorsal contour at rather more than two-thirds of the distance from its anterior end, while the posterior part appears to be slightly keeled and very slightly acuminate (in some) at the extremity. There is also, in some, a trace of slight acumination at the extremity of the sixth segment.

The epimera agree well enough with Sars' description, and, in the main, with his figure (Pl. XXI., fig. 8), but the postero-ventral corners are not produced into sharply defined angles, as in the figure referred to.

* Especially in *T. neglecta*.

The pleopods have the basal joint somewhat wider, and with a more convex anterior outline than is shown in Sars' figure, but this may be simply a difference in the point of view, since the pleopods are often seen in a somewhat oblique position.

The preanal spine is about as large as in the type, but has either only a few very coarse denticulations or none at all. This is certainly a character which varies with the size of the specimen, although the degree of denticulation is not found to correspond exactly with the total length. Sars has shown that the spine makes its first appearance in *Euphausia pellucida* as a simple structure, and we have observed it still undivided in specimens of all sizes.

Judging by Sars' figures (Pl. XII., fig. 9, and Pl. XXII., fig. 26) the dorsal denticles of the telson would appear to vary in position. In the examples which we have examined the denticles agree chiefly with the first-named figure, but some show an intermediate condition.

Locality and distribution, see p. 139.

Genus **Stylocheiron**, G. O. Sars, 1885.

Stylocheiron longicorne, G. O. Sars, 1885.

Stylocheiron longicorne, Sars.—1885.

Stylocheiron mastigophorum, Chun.—1888.

Stylocheiron longicorne, Ortmann.—1893.

We believe that Sars and Chun based their respective diagnoses on material which is not really capable of specific distinction; but if Chun's view of the matter be upheld on the examination of specimens from the whole area of distribution of the species designated by Sars and Ortmann as *S. longicorne*, our examples must be named *S. mastigophorum*, since they agree more closely with Chun's description than with Sars'.

Sars' type is mounted in Canada balsam, and has only one chela, which happens to be set on edge. It is therefore not of very much value for settling the question, but in the opinion of one of us, who has examined it, our specimens are referable to the same species.

We must, however, call attention to a feature which appears to have escaped the attention of either observer, *viz.*, the variability of the antennal peduncle, both in relative length and in the number and relative length of its articulations. The peduncle is always more than twice the greatest length of the carapace, from tip of rostrum to hindmost lateral margin, measured between verticals, but, consistent to this extent, its length varies not inconsiderably. The number of joints in the Euphausian antennal peduncle is typically three, and this number we find to be constant in *S. longicorne* in so far as regards the articulations which are conspicuous by reason of the inflation of the apposed extremities of the segments, and which we may here term the main articulations. There are, however, in many of our specimens, subsidiary articulations, not accompanied by any disturbance of the contour of the peduncle, but still apparently perfect and not due to accident, which may raise the number of joints to as many as six. The length of the joints defined by main articulations varies by variety of position of these articulations. In most of our specimens the distal main articulation is distal to the extremity of the antennal scale, as in the diagnoses and figures of Sars and Chun. In others it is proximal thereto, a phenomenon which led us to suppose that we were dealing with two species until we chanced upon a specimen (a female of adult size) in which the peduncle of one side was in this respect typical, while that of the other side had the second main articulation short of the extremity of the scale. The variation is, therefore, obviously of no taxonomic importance. It is not correlated with any variation of

other structural features, nor is it, in any of the cases we have noted above, associated with sex or with growth after the attainment of the adult condition.

The maximum length of the species as represented in the collections before us barely attains, between the tip of the rostrum and the extremity of the caudal fan, 10 mm. Males appear to be mature at 7 mm. The smallest ovigerous female which we have seen measures 8 mm. The ova are carried exactly as in Sars' figure of *S. carinatum*, agglutinated in a thin envelope of a gelatinous nature, attached to the ventrum between the sixth and seventh pair of thoracic limbs, and projecting forward between the preceding pairs. They readily escape from their investment. The few clutches which we have seen varied in number (as evidenced by both full and empty spaces in the envelope) from about 10 to about 14, and were in an early stage of development in July, 1900, in the Bay of Biscay. No ovigerous females were taken by the *Oceana* in November, 1898, off the S.W. of Ireland, nor by the *Helga* at any season of the years 1901 to 1903 within fifty miles of the S.W. and W. coasts, within which limit, as will be apparent, the species is not abundant.

With the larvae we intend to deal fully in a future report, but it may be remarked that they were taken from the earliest recognisable stage upwards, both in July and November, while the collections of adult forms in both months include a series of sizes which is sufficiently continuous to make it difficult to form any idea of the seasonal life-history of the species. The fact that the largest specimens occur in the July collections may be of significance in this respect, but may be equally explicable on the ground that the July hauls in the Bay of Biscay were nearer to the centre of distribution than those taken farther north in other months.

The following measurements, in millimetres, of adult specimens may be useful.

No. 2 is one of the largest specimens in our collection; No. 3 is an ovigerous female. We could find no specimen perfect in all respects:—

MEASUREMENTS.

—	1.	2.	3.
Total length from tip of rostrum to tip of telson,...	8·25	10·4	8·06
Carapace length, ...	2·5	3·3	2·4
Length of pleon, excluding telson, ...	4·1	5·0	4·0
„ telson, ...	·85	·93	·84
„ last segment of pleon, ...	1·65	2·2	1·65
„ eye, ...	1·0	1·2	·9
„ peduncle of antennule, ...	2·75	3·85	2·8
„ antennal scale, ...	2·1	2·85	2·2
„ chelate limb, ...	7·15	9·3	—
„ antenna (complete), ...	—	—	12·1

Locality and distribution, see p. 140.

Stylocheiron chelifer, Chun, 1888.

Stylocheiron chelifer, Chun.—1888.

(?) *Stylocheiron abbreviatum*, G. O. Sars.—1885.

Sars regarded his species as of small size, basing it on several individuals not exceeding 8 mm. in length, of which he observes that they

"would seem to be females." Such a statement does not seem to preclude the possibility of their having been immature members of either sex. Ortmann records under Sars' specific name material obtained by the Plankton Expedition, and as he makes no comment as to size, it may be taken to have consisted of equally small specimens. Chun also records the capture of *S. abbreviatum*, but we nowhere find a record of undoubtedly mature examples of that species, nor an explicit statement that its representatives have been compared with *S. chelifer* of the same size. It appears to us by no means improbable that *S. abbreviatum* is only the young (possibly of a local variety not entitled to specific rank) of the species of which the adult is *S. chelifer*, and that Sars, by the paucity and bad preservation of his material, has been betrayed into an inadequacy of description quite foreign to his wont.

In the collections which we have examined occur a number of examples which are certainly *S. chelifer*, but which, in the absence of Chun's observations, we should have referred, with some remark, to *S. abbreviatum*, and we hesitate to affirm the identity of the two species only because our series happens to be defective in the sizes comparable to Sars' types of *S. abbreviatum*.

Chun, in his descriptions of *S. chelifer*, which he regards as attaining a length of 14 mm. (some of ours reach 20 mm.), mentions the characters in which it differs from *S. abbreviatum*. He appears, however, to lay chief stress on the characters of the chelate limbs, and, in part, these distinctions appear to us to be probably not unsusceptible of explanation as phases of growth. We do not understand that he has had the opportunity of comparing a *S. chelifer* of, say, 8 mm. with a supposed adult *S. abbreviatum* of the same size.

Our material is sufficient in larvae and in adults, but the intermediate stages are not represented by perfect specimens. The proportions of the chelate limbs cannot therefore be given throughout the life-history, but we are able to show that the different parts of these limbs undergo considerable developmental modification of proportion.

——	Larval *S. chelifer*, 5·3 mm.	*S. abbreviatum*, from Sars' figure.	Adult *S. chelifer*, 20 mm.
Merus or Tibia,	100	100	100
Chela,	64·15	66	50
Carpus,	62·2	55	66
Medio-dorsal length of Carapace,	75·4	86·1	66
Sixth segment of Pleon,	56·6	47·3	27

The larva mentioned above has the antennal scale still short, and a large spine on the antennal peduncle, while the last segment of the pleon is, as appears from the table, very elongate. In other respects it has the adult form, and the chela only differs from that of the adult in that the third secondary spine of the dactylus is very minute. It is evident that the length of the carpus as compared with the merus is variable with the size of its possessor; and, as the proportions which we have given for *S. abbreviatum* depend for their accuracy on that of the figure, it is not possible to be certain that the young *S. chelifer* may not pass through a stage practically identical, in regard to proportions of segments of chelate limb, with *S. abbreviatum*. The absence, from Sars' specimen, of the third, presumably still minute, secondary spine of the dactylus is not a feature to which we should have been disposed to attach specific importance; the slender tertiary spine near the base of the dactylus in large *S. chelifer* was not present in the larva.

We subjoin a table, in which the total length of the example is made the unit of comparison:—

—	S. chelifer. Larva of 5·3 mm.	S. chelifer, 8 mm.	S. abbreviatum, 8 mm., from Sars' figure.	S. chelifer, 10·5 mm.	S. chelifer, 20 mm.
Total length,	100	100	100	100	100
Merus or Tibia,	42·7	Wanting.	33	Wanting.	48·2
Carpus,	26·6	"	19·6	"	32·5
Chela,	27·4	"	21·4	"	23·75
Medio-dorsal length of Carapace	32·2	25·8	27·7	29·2	32·5
Sixth segment of Pleon,	24·2	15·0	15·1	15·5	14·5

On the difficulty of relevant interpolation of measurements taken from a figure among others taken direct from specimens we have already remarked, but it appears that between our *S. chelifer* of 8 mm. and Sars' *S. abbreviatum* of the same size there is no great difference in the proportions of the parts which can be compared. We have, however, so much reason to respect Sars' diagnoses and figures that we prefer to leave it to him to associate *S. chelifer* with *S. abbreviatum*, if such association prove necessary.

The type of *S. abbreviatum*, which one of us has examined, does not help much, as it has lost its chelate limbs. The slight deflection of the tip of the rostrum, noted by Chun as differing from the slightly upturned condition of that process in large *S. chelifer*, is in any case a feature of little moment. In the only other *Challenger* specimen in the British Museum the deflection of the rostrum is obviously the result of accident, and may be so also in the type.

Locality and distribution, see p. 141.

Genus **Nematobrachion**, Calman.

Nematobrachion boöpis (Calman), 1896.

Dr. Calman has kindly dealt with our material in a separate paper, which will be found at page 153 of this Report.

Locality and distribution, see p. 140.

Sub-Fam. nov. *BENTHEUPHAUSINAE.*

None of the legs much longer than their immediate neighbours. Palps of the maxillae three-jointed.

Genus **Bentheuphausia**, G. O. Sars, 1885.

Bentheuphausia sp.?

Dr. Fowler's solitary specimen was taken in a haul of the vertical net between 1,250 fathoms and surface. Unfortunately the messenger, which ought to have closed the net at 500 fath., did not realise its responsibilities, and, as the net was hove thence to the surface as fast as the steam-winch would turn, the contents suffered a good deal. A big *Eucopia*, the only other Schizopod taken, reached our hands in fragments of a few millimetres long, and the *Bentheuphausia* is a mere hull, without carapace and without appendages, except eyes, part of antennules, and caudal fan.

The thing measures 8 mm. from eyes to tip of telson, and is clearly a *Bentheuphausia;* or, if not, belongs to some closely-allied genus hitherto undescribed.

The characters which remain are not exactly in harmony with those of *B. amblyops*, the only known species. In the latter—described, be it remarked, from huge specimens, the largest 48 mm.—the part of the outer uropod distal to the origin of the spine appears to be between a fourth and a fifth of the proximal part. In our specimen the apical part is relatively much shorter. What is left of the antennular peduncle agrees well enough with *B. amblyops*, but the eyes seem to be much more pyriform.

In *B. amblyops* they are narrow, somewhat medially constricted, with a small prominence internal to the visual portion. In our example the prominence and the visual part call for no comment, but the whole appendage, in its present condition, is pyriform, almost globular. It is, however, quite flaccid, and its difference in form from that of *B. amblyops* may perhaps be due merely to maceration.

Even supposing that the differences noted in the several parts are due neither to degree of development nor to imperfect preservation, it is obviously impossible to found a new species on so fragmentary a specimen.

B. amblyops, including Willemoes Suhm's material, supposed by Sars to be referable to the same species, is known from the tropical and N. and S. Atlantic and from S. of Australia at depths of 1,000 to 1,800 fathoms, but the specimens may have been obtained during the ascent of the nets through the higher strata. The question of distribution does not therefore affect the possibility of referring Fowler's example to the same species, which, while the above notes were in press, has been recorded on the authority of Sars, from a collection made in the Bay of Biscay (Richard, 1904).

Locality, see p. 141.

DIVISION.—**PERACARIDA**.—Calman, 1904.

ORDER **MYSIDACEA**.

FAM. **LOPHOGASTRIDAE.**

GENUS **Gnathophausia,** Willemoes Suhm, 1875.

Section 4 nov., cf. Sections 1-3, Sars, 1885.

Infero-posterior corners of carapace produced into a spine. Dorsal keel interrupted anteriorly. Supra-orbital spine small. Antennal scale not jointed at apex. First thoracic legs with distinctly developed exopodites. Epimeral plates of last segment not united on the ventral face.

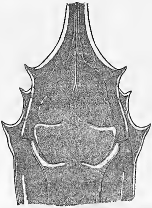
Gnathophausia drepanephora,* sp. n.

PL. XVIII.

Form of body slender. *Carapace* not very large; dorsal spine about as long as first segment of pleon; infero-posterior corners produced into a spine, bluntly serrulate on ventral edge, nearly reaching fourth segment of pleon; upper lateral keel present; dorsal keel unarmed; cervical sulcus rather distinct; rostrum elongate and slender, as long as the carapace without the infero-posterior spines, distinctly denticulate on all three edges; supra-orbital and antennal spines well-defined, but small. Branchiostegal projections of moderate proportions, but distinctly pointed.

* In allusion to the scythe-like infero-posterior processes of the carapace.

Anterior segments of *pleon* without dorsal spines; epimeral plates produced posteriorly into pointed lappets. *Eyes* very narrow, cornea scarcely at all expanded, pigment (as preserved in formol) rather pale brown. Outer flagellum of *antennule* in male expanded and flattened at the base, which is beset on the inner side with a brush-like fringe of fine curling setae. *Antennal scale* of moderate size, about four times as long as broad, tapering distally and very obliquely truncate; inner angle produced into a sharp point, outer edge with (about) three denticulations distally. *Telson* large and massive, with the terminal spines crescent-shaped and denticulate along the upper face; lateral margins armed for the usual distance with large spines, separated from each other by intervals occupied by a few smaller spines. *Uropods* shorter than telson; the proximal joint of outer uropod terminating externally in a spine about one-fourth as long as the distal joint. *Colouration* red. *Length* 39 mm.



Gnathophausia drepanephora,—Carapace.

As appears from Sars' *Challenger* monograph, some of the members of this genus reach a size which, relatively to the rest of the Schizopoda, may be considered enormous. Thus *Gn. ingens*, Dohrn, is known to attain a length of 157 mm., only an inconsiderable fraction being contributed by the rostrum.

Absolutely nothing seems to be known of the ontogeny of the genus, so that it is impossible to tell at what size the full development of the adult characters may be attained; and though one may naturally be inclined to exercise caution in founding a species on an example which, from its small size, may reasonably be suspected of somewhat imperfect development, we do not see what other course is open to us. The species *Gn. gracilis* has been founded by Willemoes Suhm and endorsed by Sars on the evidence of a single specimen of 41 mm., the rostrum being at least as elongate as in our species. One need not wish to err, if at all, in better company. *Gn. gracilis* may, or may not, grow to a large size; but if it does, though some of the characters may well undergo a measure of developmental modification, it is difficult to suppose them capable of being harmonised with those of any of the other known species. The same, perhaps in rather a less degree, is true of *Gn. drephanephora*, but there are indications that the type specimen is at least sexually mature.

Gn. drepanephora is at once distinguished from all its known congeners by the combination of two negative characters, viz., the antennal scales

are not jointed, and the epimeral plates of the last segment of the pleon are not confluent.

Description.—The single specimen, 39 mm. in length, has no incubatory lamellae. In the example of *Gn. gracilis* of 41 mm., Sars considered the absence of such lamellae to be an indication of the male sex. The specimen on which our species is founded presents, as we think, a more certain proof of its sex. The outer flagellum of the antennule is most distinctly expanded and flattened for about 3 mm. of its basal part, and is beset inwardly in this region with a dense fringe of fine curling setae, but is not separated by any well-defined articulation from the distal part. In the genus *Stylocheiron* the flagellum in the male exhibits a well-defined basal segment, expanded and beset internally with a fringe of setae, no approach to this condition being observable in the female. It appears to us that the condition observed in our *Gn. drepanephora* is of similar sexual significance. Sars appears to have detected no important secondary sexual characters in the species which he describes.

The form of the body (fig. 1) is as slender as in *Gn. gracilis*. The carapace is, in comparison with some members of the genus, rather small, and does not completely cover the last segment of the thorax. Posteriorly it is not unlike that of *Gn. calcarata*, but the dorsal spine is more upturned and the infero-posterior corners are more produced and terminate in longer spines. The latter are only bluntly serrulate on the lower edge. Both lateral keels are well marked, the lower one being closely approximated to the ventral border. The rostrum does not differ materially, in length, shape or armature from that of *Gn. gracilis*. It is a character which appears to us to be likely to undergo modification as growth proceeds, even after the assumption of sexual maturity, so that larger examples (if such exist) of the species may prove to exhibit relatively shorter rostra. The supra-orbital and antennal spines are small; the branchiostegal projections, though only of moderate extent, are most distinctly acuminate, but the margins of all these processes are entire. In considering the possibility of the attainment by our example of the characters of *Gn. calcarata*, in which the processes referred to are much more developed, it is of interest to note that in *Gn. gracilis*, which is hardly larger than *Gn. drepanephora*, the spines are already extremely well pronounced (*cf.* Sars, *loc. cit.*, Pls. IV. and VII). The two anterior segments of the pleon are very slightly keeled on the dorsum, and also transversely sulcate, the contour being thus somewhat irregular. The hinder edges of these segments, and, to a less degree, of the third and fourth, are somewhat upturned. The epimera exhibit only a posterior lappet, produced into a well-defined point except in the anterior part of the last segment, where the lappet is reduced to a denticle. It appears to us to be within the bounds of possibility that the confluence and backward growth of the epimeral plates of this segment, as exemplified in the large individuals of Sars' Section 1, may be a feature of late growth, but of this there is no sort of evidence. In our example the denticles are widely separate.

The eyes are very small and narrow, the ocular papilla occurring as a small spine rather near the distal extremity. In general form they appear similar to those of *Gn. calcarata* and, probably, of *Gn. gracilis* also. In respect of the pigment, which is brown and can hardly be described as dark, *Gn. drepanephora* would appear to differ from its congeners, the visual sense being perhaps imperfectly developed.

We have already alluded to the structure of the basal portion of the outer flagellum of the antennule (Fig. 2). The whole flagellum is at present 22 mm. in length, and must have been a good deal longer. The inner flagellum is somewhat longer than the rostrum.

The antennal scale (Fig. 3) approaches that of *Gn. gigas*, from which, however, it differs in its narrower and more acuminate outline and in the smaller number of the denticulations of the outer edge. The flagellum is about as long as the inner flagellum of the antennule.

Of the oral parts we can only say that the epipodite of the first thoracic leg is well developed, and that the pigmented protuberance of the second maxilla is conspicuous.

The legs appear to us to be relatively somewhat slender as compared with other species.

The telson agrees very closely with that of *Gn. calcarata*. It is about equal in length to the sum of the three preceding segments of the pleon. The lateral margins are evenly arched, and armed, as in *Gn. calcarata*, with large spines separated by intervals of smaller spines. In *Gn. calcarata* the smaller spines are represented by Sars as more numerous, but we have found in similarly armed Schizopods (*e.g.*, *Siriella*) that such a difference is not of specific constancy. The occurrence in *Gn. drepanephora* of several spines (one on the right side, two on the left, nearly opposite the distal ends of the outer uropods) about twice as large as any other, may be a feature of specific moment, though our experience of other forms inclines us to regard it as more probably illustrative of individual variation. The apical crescent appears to us to be exactly similar to that of *Gn. calcarata*.

The outer uropod is characterised by the great development of the spine at the distal end of the outer margin of the proximal joint, the spine being about one-fourth as long as the terminal joint. In *Gn. calcarata* the spine, though perhaps more developed than in the remaining species, is only about one-sixth of the dimension which we have used for comparison. The difference can hardly be explained by difference of age, since the spine is quite inconspicuous in *Gn. gracilis* at 41 mm. The outer margin of the appendage is more inflated than in *Gn. calcarata*.

The colour, after preservation in a weak solution of formol for twelve months, is pinkish, the setae, keels of the carapace, and margins of the integument generally being red.

Locality, see p. 142.

Fam. MYSIDAE.

Sub-fam. *LEPTOMYSINAE*, Norman, 1892.

It is reasonable to infer that Norman considered the presence of an antennal scale to be a character of this sub-family. It serves to separate it from the *Arachnomysinae*.

Genus Meterythrops, S. I. Smith, 1879.

Parerythrops (pars.), G. O. Sars, 1879.

The genus *Meterythrops* was instituted in 1879 by Smith for the reception of a species, *M. robusta*, found by him off the coast of N. America. The genus, as stated by Smith, appears to combine several characters of *Erythrops* and *Parerythrops*, agreeing with the former in the pleopods of the male and with the latter in the general form of the antennules, antennae, and oral parts. The telson also approaches that of *Parerythrops* very closely.

Sars, however, has included *M. robusta*, the type species of the genus, in his own genus *Parerythrops* without, to our knowledge, in any way modifying his original diagnosis of that genus, which would exclude *M. robusta*, as the first pleopods of the male are *not* as in the female but as in the male of *Erythrops*.

In view of the present additions to the *Erythrops* group, it appears to us convenient to retain Smith's genus, in which the pleopods of the first pair in the male are as in *Erythrops*, reserving for *Parerythrops* those forms which have the first pleopods in both sexes vestigial.

Meterythrops picta, sp. n.

Pl. XIX. figs. 5-7, and Pl. XXV., figs. 8-9.

Form moderately stout. *Carapace* not much wider than pleon, rostral region obtusely arcuate, posterior margin rather deeply emarginate. *Eyes* large, sub-globose, reaching the level of the second joint of antennular peduncle. Colour pale golden brown. *Antennular peduncle* with

the last joint (in immature male) as long as the two preceding; male appendage present (small and with but few setae in the type specimen). *Antennal peduncle* as in *M. robusta*. *Antennal scale* about four times as long as broad, exceeding by about one-third of its length the extremity of the antennal peduncle; external margin slightly curved, its distal half coarsely denticulate with about four teeth rather widely separate; terminal spine of moderate size; apex obtusely rounded, extending slightly beyond the terminal spine. Setae strong. *Endopodite of second thoracic limb** somewhat shorter, proportionally, than in *M. robusta*; merus slightly longer than carpus, and bearing only a few setae, on its inner edge; carpus moderately, propodus and dactylus densely, setose, the setae serrated and jointed. *Exopodite of second thoracic limb* shorter than endopodite; tooth of the outer distal angle of basal joint very minute and almost obsolete; flagelliform part composed of ten joints, as also in succeeding limbs. *Endopodites of the remaining thoracic limbs* with tarsus of three joints, and distinct dactylus; tarsus shorter than the proximal joints taken together and barely longer than merus. *Pleon* slightly longer than carapace; sixth segment about twice as long as fifth. *Telson* about as long as sixth segment of pleon; twice as long as wide at base; half as long as outer uropod; triangular, apex narrowly truncate, armed with a median pair of setae and two pairs of spines, of which the inner are about twice and a half as long as the outer, and more than one-third as long as the telson. *Inner uropods* about one and a half as long as telson, no spines on the under side. *Outer uropods* about twice as long as the telson. *Colouration* after preservation—eyes pale golden yellow, general colour of trunk pale brownish yellow, with patches of deep brown in the region of the stomach, and on the posterior part of the thorax.

Length of immature male 11 mm.

The species is easily distinguished from its allies by the characters of the antennal scale. Our solitary example is an immature male, and it may be inferred that, though probably smaller than *M. robusta*, the full size is greater than that attained by other Leptomysine genera.

Locality, see p. 143.

Genus Katerythrops, n.

Characters of the pleopods in the adult male uncertain, pleopods of the female unknown. Other characters as in *Meterythrops*, S. I. Smith (*vide supra*), except—

Antennal scale considerably reduced in length in proportion to peduncles of antenna and antennule, narrow and feeble, its outer margin naked, entire, terminating in a small spine, setae few, confined to the apex and distal third (approximately) of the inner margin.

Telson possibly without the median setae.

The type of the species upon which we found this genus is a young male in which the pleopods are not sufficiently developed to reveal the adult condition. Their condition, however, as will appear, points to the probable agreement of the genus in this respect with *Meterythrops*. The exopodites of the thoracic limbs are larger than in the bottom-haunting genera of the family—*Erythrops*, *Parerythrops*, *Meterythrops*, &c.—and approach the condition found in the pelagic *Euchaetomera*.

Katerythrops Oceanae, g. et sp. n.

Pl. XX.

Form robust. *Carapace* much wider than the pleon, almost entirely covering the thoracic segments, anterior margin obtusely rounded, cephalic region inflated and posteriorly defined by a well-marked cervical sulcus. *Pleon* with the last segment almost as long as the two preceding segments taken together. *Eyes* small, remote from each other, sub-pyriform, the proximal part the broader, visual area restricted to less than

* *i.e.* the *first leg* when, as in the original diagnosis of the genus, the first thoracic limb is termed a maxillipede.

the distal half, cornea not so wide as the last joint of the antennular peduncle, pigment after preservation in formalin reddish-buff. *Peduncle of antennule* at least a fifth longer than the last segment of the pleon, proportionally stout, its last joint about equal to the two preceding, beset dorsally between the insertions of the flagella with a bidentate tubercle, of which the denticles are nearly in the same dorso-ventral plane. *Antennal scale* very short, narrow, and somewhat outwardly curved, outer margin entire, naked, terminating in a feeble spine; apex produced considerably beyond the spine, sub-acute, setae confined to the apex and to about the distal third of the inner margin; length of scale more than four times (about 14:3) the greatest width, slightly less than the combined length of the last two joints of the antennal peduncle and but little exceeding the length of the last joint of the antennular peduncle. *Antennal peduncle* long and proportionally stout, combined length of the last two joints greater than that of the last joint of the antennular peduncle. *Exopodites of the thoracic limbs* very well developed, with unusually large flagella. *Endopodites* of the first four pairs moderately long and stout; the tarsus in the third and fourth pairs consisting of three joints, and succeeded by a well-developed dactylus, setae not more plumose than in *Parerythrops, &c.* *Pleopods* of all five pairs biramous in the male, the inner ramus bifid. *Telson* subtriangular, shorter than the last segment of the pleon by about two-sevenths of the length of the latter, its sides entire and slightly inflected; apex narrowly truncate, armed with two pairs of rather slender spines, of which the inner are considerably the longer and stouter; a median pair of setae possibly present. *Outer uropod* the longer, its length, including basal articulation, slightly greater than the combined length of the fifth and sixth segment of the pleon. *Length* of the type specimen, an immature male, 6 mm., including antennular peduncles and uropods.

Description.—The type-specimen being, as we consider, immature, the diagnosis has been confined to a few characters, and must be held liable to some slight modification in the proportions of the different parts.

The general form (Figs. 1 and 2) appears to be distinguished from that of the known species of *Parerythrops* and *Meterythrops* by the greater convexity of the dorsal contour of the cephalic region of the carapace.

The eye is extremely small, the visual portion occupying an unusually small proportion of the whole appendage, while the proximal portion is unusually inflated. A minute papilla occurs dorsally at the edge of the cornea.

The antennule offers no peculiarity; it is devoid of any trace of a sexual process.

The antenna is characterised by the reduction of the exopodite or antennal scale, showing in this respect an approach to *Anchialus* and *Caesaromysis*. The endopodite differs from *Parerythrops* and from *Meterythrops* in the proportions of its basal joints. In those forms the three basal joints are short and do not greatly differ in length. In *Erythrops* the proximal joint is greatly reduced, while the median and distal joint are elongate. In the form before us the basal joints agree with *Erythrops* in relative length, but are proportionally much stouter. A somewhat natural inference that the endopodite and exopodite of this appendage vary in development in inverse ratio to each other appears to receive support from the analogy of *Anchialus* and *Caesaromysis*. In the latter (*cf.* Ortmann, Decap. u. Schizop., Plankt.-Exped., p. 24, Pl. I., Fig. 8c.), in which the scale shows its greatest degree of reduction, the basal joints of the endopodite are enormously developed, while in *Arachnomysis* the scale has disappeared, and the flagellum is enormously developed at the expense of the peduncle. In respect of scale and peduncle, *K. Oceanae* appears to occupy a position intermediate between *M. Picta* and *M. robusta* and the species of *Parerythrops* on the one hand and *Erythrops* on the other. The flagellum is stout and probably long, but is not remarkable in these respects in comparison with the most nearly allied

forms. Fig. 3 shows so much of the appendage from a slightly oblique dorsal view as may be seen without removing the eye.*

In so far as their characters are distinguishable *in situ*, the oral parts offer no peculiarities likely to be useful in determination.

The same remark applies to the legs, of which only the four anterior pairs remain. The natatory exopods are more strongly developed than in *M. robusta* and the species of *Parerythrops*. They are shown, in Fig. 1, approximately in their present position, but their extremities are actually directed somewhat more upwardly and inwardly.

The genital appendages are short and somewhat tapering. Their extremities, which appear devoid of setae, being forwardly and inwardly directed between the bases of the last pair of legs.

The pleopods appear to be in a very immature condition, but suffice to show that the species cannot be assigned to the genus *Parerythrops*, as originally defined by Sars. Until an adult male can be examined it is impossible to affirm that we are right in regarding them as like those of *Meterythrops*. Each pleopod consists of a short basal joint, giving rise to two processes, (i.) an endopodite, devoid of articulations, but furnished near the base with a short lateral process, each extremity bearing a few setae; (ii.) an exopodite in the form of a short digitiform process, devoid of setae. In the anterior pair the endopodite and exopodite are subequal in length. In the remaining pairs the endopodite is the longer, being, in the fifth pair, more than twice as long as the exopodite (Fig. 2). In adult males of allied forms the endopodite and exopodite are subequal in length, or, in the first pair in *Meterythrops* and *Erythrops*, the exopodite is much the longer. The material examined in this group throws no light on the development of the pleopods, but in a series of young males of *Siriella Clausi*, a form in which the pleopods are approximately identical in structure with those of *Meterythrops*, we find that the endopodite is the more precocious and is biramous and setiferous at the extremities at a period when the exopodite is still devoid of setae. The endopodite is also the longer in early stages, though we have observed no such difference in length as is exhibited in the fifth pair of the form under consideration. The developing endopodite in *Siriella* is more pointed at the extremity than in *K. Oceanae*, but in other respects the conditions are so similar that it appears safe to regard our example as immature.

The telson is much shorter than in *Meterythrops*. Its lateral margins are nearly straight (Fig. 6). The inner pair of spines are about one-fifth as long as the telson, and are longer and much stouter than the outer pair, of which one is missing in our largest example. Under a high power of the microscope we can detect no trace of a median pair of setae, such as occurs in *Meterythrops* and in *Parerythrops*. Its absence may possibly be due to imperfect development, or to damage.

The inner uropods are not much shorter than the outer. No spines are visible on the ventral surface near the inner margin, but may occur at a more advanced stage, as the spinulation of this region has been observed to vary in other forms with the degree of development.

The lateral parts of the carapace are closely speckled with small dark chromatophores, a median line of which occurs also on the telson. Pigment, except in the eyes, is not distinctly visible in any other part, but the gastric region appears dark in colour.

Locality, see p. 143.

Genus **Hypererythrops**, n.

Characters of the distal parts of the endopodites of the third to eighth thoracic limbs, and pigment, unknown. Other characters as in *Erythrops*, G. O. Sars, except—

Telson well developed, not unusually short; lateral margins armed with spines; apex broadly truncate, armed with a median pair of setae and about three pairs of spines.

All the *thoracic* and some of the *abdominal segments* in the males armed with median ventral processes.

*Ortmann's key to the genera of Mysidae (*op. cit.* pp. 2'–22), requires some verbal modification in order to associate the present species with its nearest allies, since the antennal scale is apparently no larger than that of *Anchialus pusillus* (*cf.* Sars, 1885).

Hypererythrops serriventer, g. et sp. n.

Pl. XXIII. and Pl. XXIV., Fig. 4.

Form moderately stout. *Carapace* wider in the thoracic than in the cephalic region; anteriorly produced and rounded, but not forming a distinct median linguiform process; produced beneath the eyes into acute angles. *Labrum* with a well-developed blade-like process; a small spinous process immediately in front of it. *Eyes* rather large, set close together, the anterior and posterior margins of their peduncles not noticeably differing in length; colour orange-brown after preservation. *Antennular peduncle* with the basal joint as long as the two remaining, its outer corner produced into a somewhat acute process tipped with three or four setae; middle joint much the shortest of the three; distal joint with a small spine at its inner distal corner, male process of moderate size but very hirsute. *Antennal peduncle* with the proximal joint small, middle joint once and a half times as long as the distal; these last two joints beset at their inner distal angles with a bunch of setae. *Antennal scale* about three times as long as broad; outer margin entire, terminating in a strong spine, the extremity of which is about at the level of the extremity of the peduncle; apex very obliquely truncate, about one-third of the length of the scale being beyond the extremity of the spine; extremity of scale at about the level of that of antennular peduncle. *Mandibles* generally as in *Erythrops*, three-jointed, first joint small, second longer than third and unusually broad, its greatest width being more than half (17:30) of its length; last joint tipped with a fine seta as long as itself. *First and second Maxillae* generally as in *Erythrops*. *First thoracic limb* with endopod as in *Erythrops*, exopod with a small spine at its distal angle, flagelliform part with nine joints. *Second thoracic limb* with endopod proportionally shorter and stouter than in *Erythrops*, carpus much shorter than merus. Exopods of *second and succeeding thoracic limbs* with flagelliform parts of ten joints. *All the thoracic limbs* with small forwardly directed digitiform epipodites on the basal parts. *Ventrum*, in the male only, armed between each of the pairs of thoracic limbs with a forwardly directed sickle-like process, terminating in a stout spine, its posterior or inferior edge beset, except proximally, with short spines; also armed between the first to third pairs of pleopods with short simple spineless processes. *Pleon* distinctly narrower than carapace, the sixth segment about as long as the two preceding taken together. *Pleopods* generally as in *Erythrops*, but with the second to fifth of the male having the lateral lobe of the inner ramus produced inferiorly into a considerable ovoidal slightly pedunculate lamella of about one-third of the length of the whole ramus. *Telson* more than half as long as the inner uropod; its apex broadly truncate but somewhat rounded at the angles, armed with a median pair of setae and with one small and two large spines on either side, the outer spines the longest; lateral margins armed on about the distal three-fourths with a series of about seven to nine spines increasing in length from in front backwards the posterior spine incurved and occupying the angle of the apex. *Inner uropods* somewhat the shorter, unarmed ventrally. Otocyst somewhat unusually inflated.

Length of adult males and females, 10 mm.

Our material consists of males and females, all of which are either mature or have so nearly attained maturity that we are unable to throw any light on the distinctions which may exist between young and old individuals.

The peduncles of the antennules have the sexual differences which are familiar in *Erythrops*, and the mouth-parts are of the same type as in that genus. The most obvious generic distinction, for present purposes, is found in the telson, which is considerably larger than in *Erythrops*, and has the lateral margins armed with spines.

The peculiar median ventral processes, found, among adults, in the male only, appear worthy to figure in the generic diagnosis. Their func-

tion might be more obvious if we had any means of knowing the characters of the thoracic legs, but only one specimen in our material possessed even the two anterior legs, and these are not very different from those of *Erythrops*.

The thoracic median ventral processes (see fig. 8) are all much alike in size and shape. They do not project, ventrally, below the bases of the endopodites of the limbs, but their extremities pass in front of the limbs between which they arise. The terminal spines are comparatively large and stout, and those of the inferior or posterior edge, which are in part set in more than one row, are stout though very short. Among Mysidean spines they are unusually deciduous, the appendages in some specimens being wholly stripped of spines, though their facets of attachment are clearly visible.

The abdominal median processes are simple, laterally compressed and small in the first to third segments of the pleon. In posterior segments they may be traced as papillae, which we have not thought worthy of note in the specific diagnosis.

Sars has figured, in an immature female ascribed to *Erythrops serrata*, a series of apparently homologous structures between the thoracic limbs. They are narrowly pedunculate globular processes set with radiating spikes. The author does not mention them except, very briefly, in his discussion of the genus, and we have not been able to find them in a fairly large collection of immature and mature Irish *E. serrata*. The phenomenon is not likely to be of a pathogenic character, and we hazard the suggestion, with the respect due to Sars, that the example in which they were found may belong to some species very closely related to *E. serrata*, but otherwise unknown.

Structures apparently homologous with those which, in *Hyperythrops*, we term epipodites, are shown by Sars in the same figure, but they are depicted as simple proliferations of the base of the limb rather than as distinctly digitiform processes, such as are shown in our fig. 8. Epipodites are found in even better development in *Euchaetomera Fowleri* (see p. 123).

The characters of the second to fifth pleopods of the male *H. serriventer* require somewhat more prolix notice than is compatible with specific diagnosis. Taking a typical *Erythrops* pleopod, the condition of the species before us would be achieved by the addition to the ordinary simple digitiform lobe of the endopodite, with its terminal setae, of a sub-pedunculate lamella arising from its inferior surface. Consideration of the generic value of such a departure from the condition of the known *Erythrops* group may be safely deferred until it be met with in other forms, as yet safe from the zoological pillory.

Locality, see p. 144.

Genus Dactylerythrops, n.

Characters, as far as they can be diagnosed in the absence of the thoracic limbs, generally as in *Meterythrops*, S. I. Smith, except—

Eyes small, with distal processes, visual elements imperfectly developed.

Telson sub-triangular; apex narrowly truncate, armed with a pair of spines on either side of a pair of setae; lateral margins armed with a few spines distally.

Dactylerythrops dactylops, g. et sp. n.

Pl. XXII.

Form robust. *Carapace* of nearly even width throughout, anteriorly gibbous, anterior margin obtusely rounded, posterior margin somewhat emarginate. *Eyes* small, remote from each other, their inner faces bound to the anterior margin of the head by a wide membranous integument: visual elements in the form of six to eight plates set in mosaic about a central pyriform body; distal extremities produced into digitiform flexible processes about as long as the visual parts. *Antennular peduncles* with the distal joint much the longer; much more robust in the male than in

the female. Male appendage very hirsute. *Antennal scale* about three and a half times as long as broad; outer margin slightly curved, terminating in a spine of moderate size; apex rather obtusely rounded, produced considerably beyond the spine of outer margin, reaching or slightly exceeding the level of the distal extremity of antennular peduncle. *Basal joint of antenna* wide and massive, distal joint of peduncle of flagellum the longer, reaching to about the distal third of antennal scale. *Mouth organs* (as far as can be made out in the absence of dissection) as usual for *Meterythrops.** *Thoracic* limbs (of which the endopodites are all wanting) with the flagellate parts of the exopodites nine-jointed; male appendages well-developed, but of moderate length; female with two pairs of incubatory lamellae. *Pleon* with the first five segments sub-equal, the sixth about one and a half times as long as the fifth. *First pleopods* in the male with the inner rami bifurcating into two narrow sub-equal processes, without any conspicuous basal enlargement. *Telson* sub-triangular, about as long as the sixth segment of pleon, apex narrowly truncate, beset with a central pair of setae and a pair of spines on either side. The inner spines are three or more times as long as the outer and about as long as the telson. Lateral margins entire, except distally, where there are about three small spines on either side. *Outer uropods* with the extremities somewhat squarely truncate. *Inner uropods* but little shorter than the outer, armed inferiorly with a single spine near the posterior end of the otocyst. *Colouration* not noted when the specimens were taken. One retains a crimson spot on the cephalic part of the carapace. *Length* of mature male and female 9 mm.

The characters of the eyes and telson serve to readily distinguish this species from its nearest allies (*Meterythrops*, &c.). It is evidently quite a small form, since the range in size of mature examples in this group is inconsiderable.

The appearance of the ocular processes suggests a tactile function, since they seem to have a central core continuous with the nervous part of the eye, though, in view of their position, it is difficult to imagine what useful purpose they could serve. It is possible that they are only spinous in function, as seems to be probably the case in *Paramblyops* and some other forms. So far as can be judged from optical section, the eyes can be of little value for visual purposes, while the fold of integument which binds them to the central part of the head must render them practically immobile.

The species is known from three examples—one taken in a tow-net attached to a dredge fished at 199 fath., and two, in a tow-net on the back of the trawl at 382 fath. The dredge certainly did not seem to have spent much time on the bottom, and the tow-net on the trawl was of course fishing more or less during the ascent of the trawl. It may be significant that no specimens were found among numerous Mysids, Amphipods, &c., in a tow-net on the trawl at 199 fath., which got filled with sand and (it may be presumed) bottom-haunting organisms only.

While obviously differing in form from *Euchaetomera*, *Dactylerythrops* rather closely resembles *Katerythrops*, which is only known as pelagic, and equally resembles *Meterythrops*, apparently a bottom genus.

Locality, see p. 143.

Genus **Parerythrops**, G. O. Sars.

Parerythrops obesa, G. O. Sars.

The characters which separate *P. obesa* from *P. abyssicola* are not of a very tangible nature, apart from the size of the eyes, as to which one has to depend on Sars' figures rather than on his text. In the examples of 7 to 10 mm. which we refer to this species, the diameter of the facetted part of the eye is nearly equal to the length of the telson, *i.e.*, about as 12 to 13. In *P. abyssicola* the telson is depicted as relatively much longer.

Locality and distribution, see p. 144.

*One of our specimens shows a peculiar abnormality in the mandibular palp, that structure being branched on the right side while the left side is quite normal.

Genus Euchaetomera, G. O. Sars.

This genus appears to be very closely allied to *Erythrops*, with which it agrees in the general characters of the male pleopods. The most striking differences are found in the feeble and lamellar character of the telson, which is devoid of large spines on the apex, and in the partly bilobate structure of the eyes. The ciliation of the setae of the thoracic legs, from which the generic name is derived, would seem to be noteworthy only in the type species, *E. typica*. It does not appear to be of a nature to attract attention in *E. tenuis*, and in the species described below it is hardly more noticeable than in *Erythrops*. The legs, however, are very slender, and in general structure *Euchaetomera*, as compared with other members of the *Erythrops* group, is distinctly pelagic in character.

Euchaetomera Fowleri, sp. n.

Pl. XXIV., Figs. 1—3.

Form slender. *Integuments* thin and diaphanous. *Carapace* with the anterior margin forming a very obtuse angle in the rostral region, its apex considerably posterior to the origin of the peduncles of the eyes; its posterior margin not deeply emarginate. *Eyes* large, closely apposed, sub-rhomboidal and slightly bilobate, their functional facets confined to an anterior part, with long retinal elements, and a postero-lateral part with short retinal elements; these parts deeply pigmented, the pigment dark brown after preservation, the remainder of the eye being pale brown, with facets vestigial and probably functionless. *Antennular peduncle* about one and a half times as long as the eye, distal joint as long as the two preceding, male appendage densely setose in the adult; internal flagellum very long, the proximal joints remarkably setose. *Antennal peduncle* nearly as long as antennular peduncle, its last joint shorter than the preceding. *Antennal scale* slightly curved, about five times as long as broad, extending for about one-seventh of its length beyond the antennular peduncle; external margin entire, terminating in a very feeble spine; apex obliquely truncate, extending beyond the spine. *Thoracic limbs* in the male with well-developed exopodites, the basal part terminating in a minute spine; flagelliform part with eleven joints, and, in the last three pairs of limbs, of about five-sixths of the length of the carapace. *Pleon* somewhat narrower than the carapace, with the first five segments sub-equal, the sixth considerably longer than the two preceding segments. *Telson* short, its lateral margins slightly arcuate and unarmed; apex slightly arcuate, its exterior angles armed with two closely-set short slender spines; median setae not closely apposed, somewhat less distant from each other than from the angular spines. *Outer uropods*, including basal articulation, about once and a half times as long as the sixth segment of pleon; narrow, with the apices obliquely truncate and hardly at all rounded; setae somewhat widely separate, about eleven on the outer margin. *Inner uropods* considerably shorter than outer; otocyst very large, extending to or beyond the extremity of the telson; distal part narrow, the apex rounded; no spines on the inferior surface; no denticulations on the inner edge.

Length of adult male and female 9 mm.

E. Fowleri is very closely allied to *E. tenuis*, described by Sars from the S. Pacific off Chili. It is, however, readily distinguished by three characters—(i.) the eyes have no dark pigment except at the anterior and postero-lateral functional parts; (ii.) the rostrum, if it can so be called, is much more obtuse in *E. Fowleri*; (iii.) the telson has two distinct, if minute, spines at each angle, and the setae arise at a considerable distance from each other.

In both the specimens taken by Dr. Fowler the setae of the telson are represented only by prominences which mark their origin. The telson of one specimen (a female) is in bad condition and appears to have been shrivelled up, so that the nature of the angular spines cannot be deter-

mined. In the male the telson is in good condition, and at the left angle are seen two minute slender spines, which arise close to each other. The outer spine curves inwards, so that its distal part comes to lie in nearly the same vertical plane as the inner. Of the spines of the right angle only the outer remains, but the base of the inner is visible. The condition is quite different from that of *E. tenuis*, in which there appears to be only a denticulation, and not a true spine, at each angle of the telson.

In the two specimens two thoracic limbs remain, the first and second. They are very slender, as compared with *Erythrops*, and have the carpus as long as the merus.

The exopods only of the remaining thoracic limbs of the male are present, and they are in every way normal in structure.

The posterior thoracic limbs of the female specimen appear to be arrested in their development. The endopodite consists of five joints (including the small dactylus) very imperfectly defined, the penultimate joint, which corresponds to the future tarsus, being still unjointed. The tip of the dactylus is rounded and transparent. The flagellum of the exopod is likewise devoid of articulations, and the whole limb is devoid of setae.

Well developed epipodites, such as we describe for *Hypererythrops serriventer*, are present in this species as well.

We are unable to say whether this condition of the development of the legs in the female is normal for this species or not, owing to the endopodites of the legs in the male having broken away. But it may be noticed that the female has well-developed incubatory lamellae, and the male, which is of exactly the same size, has the brush of setae on the antennules remarkably well-developed. Moreover, in the male the exopodites of all the limbs are well developed.

Beyond noting the shape, Sars devotes no special attention to the eyes of *E. typica* and *E. tenuis*, but it is probable that their structure is the same as that of *E. Fowleri*, in which the absence of pigment from the non-functional parts of the facetted area enables the visual elements to be clearly seen in optical section. They do not appear to differ in any important particular of internal structure from the eye of *Stylocheiron*, as described by Chun (1896). Among known Mysids *Euchaetomera* is the only genus in which such a sub-division of the visual elements has been observed. It occurs in several genera of *Euphausiidae*, presumably in all which have bilobate eyes, such as *Thysanoessa, Nematoscelis, Nematobrachion* and *Stylocheiron*, and in *Phronima* among amphipods. The taxonomic value of this character is therefore of no apparent moment, while its bionomic import is rendered doubtful by the existence of normal crustacean eyes in such pelagic forms as the *Sergestidae*, *Euphausia* and immediate allies among *Euphausiidae*, *Katerythrops* (if truly pelagic) among *Mysidae*, and numerous pelagic genera of amphipods.

Locality, see p. 144.

Genus **Paramblyops**, n.

Characters generally as in *Amblyops*, G. O. Sars, except—

Carapace of moderate size, produced anteriorly in subtriangular form, in part occluding the eyes.

Eyes imperfectly developed, without visual elements, rather flattened, outer angles rather acutely produced.

Telson with the apex broadly truncate.

Amblyops has the carapace large (*magnum*). If sufficiently large to really merit generic stress in *Amblyops*, it is not so in *Paramblyops*. The telson in the type species of the latter lacks the median setae, but this character is perhaps hardly worth mention in generic diagnosis.

But for the inconvenience of, at present, meddling with Sars' definition of *Amblyops*, that genus might be easily expanded to admit *Paramblyops*, which is in general character merely an *Amblyops* with the anterior margin of the carapace produced into a rostral hood. Its resemblance in this respect to the *Calyptopis* larva of an Euphausian is suggestive, but there is little probability of phylogenetic kinship in the evolution of the

two conditions. A development of protective armature in compensation for loss of sight is familiar enough, and the diversity of means by which the same end may be accomplished in closely allied forms is illustrated by comparison of *Paramblyops* with *Pseudomma*. In both the front dorsal margin is provided with an edge of fine denticulations, but whereas in the former these are of the carapace, the eyes contributing nothing but a small spinous process not impossibly tactile rather than protective in function, in *Pseudomma* the denticulate edge is furnished by the eyes themselves, flattened and united into a broad shield extending beyond the carapace, but not, in the known species, presenting any considerable pseudo-rostral proliferation.

Paramblyops rostrata, g. et sp. n.

Pl. XXI.

Form moderately stout. *Carapace* wider than pleon, posteriorly emarginate, not covering the last thoracic segment; the whole of the antero-dorsal margin produced in subtriangular form and depressed, the sides inflexed; the apex or rostrum longer in the female than in the male, reaching in a dorsal view to about the middle of the antennal scale in the latter, and to about the distal third of the scale in the former sex;* its edges finely denticulate except at the extremity. *Eyes* without visual elements, rather small, sub-fusiform, partly occluded by carapace, somewhat flattened, very minutely scaled or hispid anteriorly, produced distally into short spine-like processes. *Antennular peduncles* with the first joint produced rather acutely at its outer distal corner, the tip of the process bearing a bunch of setae, middle joint small, last joint longer and stouter than the preceding, much longer and stouter in the male than in the female, furnished in the male with an appendage of the usual form, but (in our material) devoid of the usual brush of setae. *Antennae* with a pair of spines on the outer face of the basal joint. *Antennal scale* four times as long as broad, outer margin terminating in a short stout spine, apex obtusely truncate, not extending beyond the terminal spine. *Labrum* produced into a blade-like process about as long as the rostral prolongation of the carapace. *Mouth parts* as in the genus *Amblyops*, except that the mandibular palp is not as setose. *First thoracic legs* as in *Amblyops abbreviata*. *Second thoracic legs* somewhat stouter and relatively shorter than in *Amblyops abbreviata*, with the merus a little longer than the carpus, the latter somewhat expanded distally; propodus small and densely setose, nail distinct, exopod with the basal joint produced at its outer distal angle into an acute spine, the flagelliform part of nine joints. The remaining *Thoracic legs* long and slender, the tarsus shorter than the merus, three-jointed, and terminated by a distinct nail; exopods of the remaining thoracic legs similar to that of the second leg. *Pleon* longer than the carapace, the first five segments sub-equal, the sixth about as long as the two preceding ones taken together.

Pleopods rudimentary in the female, all natatory and biramous in the male, the inner ramus of the first pair short, non-articulate, nearly devoid of setae on the distal parts; inner rami of all the pairs with a lateral basal lamina. *Telson* very massive and strongly armed, about as long as the last segment of the pleon, apex widely truncate, its breadth equal to a quarter of the length, armed with five pairs of spines, the median pair very small, the second pair from the inside very little longer than the median pair and slightly serrate at their bases, the outer three pairs of spines long and very stout, the median of the three pairs being slightly the longest. Lateral margins armed with about fourteen to sixteen short stout spines. *Outer uropods* about one-fourth longer than the telson. *Inner uropods* but little shorter than the outer ones, armed inferiorly with a single minute spine at the level of the posterior end of the otolith.

Length, about 10 mm.

Locality, see p. 144.

*The deflection of the rostrum appears to be somewhat variable, and of course affects the apparent length of the structure in a dorsal view.

Genus **Pseudomma**, G. O. Sars.

Pseudomma calloplura,* sp. n.

This new species having come to hand after our notes had gone to press, only a brief preliminary diagnosis can be given here, viz:—

Form much as in *P. roseum*, sublinear in dorsal view, generally compact. *Carapace* obtusely rounded in front, emarginate behind. *Pleon* longer than the carapace, with the last segment one and a half times as long as the preceding. *Antennule* with the usual setose appendage in the male. *Antennal scale* about five times as long as broad, extending for nearly half its length beyond the antennular peduncle; outer margin entire and terminated in a short spine, tip of scale not extending beyond the terminal spine of the outer margin. *Eyes* in the usual form for the genus, of two rectangular lamellae devoid of pigment and visual elements, antero-lateral and lateral edges with about twenty small teeth. *Labrum* produced into an acutely pointed process. *First thoracic legs* much as in *P. roseum*, but the merus relatively shorter and the carpus rather longer. *Second thoracic legs* more slender than in *P. roseum*, merus longer than carpus, propodus short, dactylus distinct, not so densely armed with setae as in *P. roseum*. *Remaining legs* missing. *Pleopods* normal in structure. *Telson* about as long as the last segment of the pleon and a little shorter than the inner uropods, apex rounded and armed with three pairs of long strong spines, each spine being itself 'feathered' with short setae; lateral edges of the telson armed with twelve or thirteen small spines on the distal two-thirds of their length. The median setae usually present at the apex of the telson in species of *Pseudomma* are wanting in this species. *Outer uropod* about one quarter longer than the inner, which is slightly longer than the telson.

Length 10 mm.

Colour of preserved specimens white with a rosy red patch on the carapace behind the eyes.

Locality, see p. 145.

This *Pseudomma* differs from all the other species of the genus, except the following, *P. Theeli* (Ohlin, 1902) and *P. parvum* (Vanhoffen, 1898), in the form of the antennal scale. The telson is distinguished by the absence of median setae and by the plumose character of the terminal spines. *P. parvum* has no median setae, but the terminal spines, though of the same number as in *P. calloplura*, appear to be simple. It is a Greenland form from 193 fathoms, and is only known from Vanhöffen's very brief diagnosis of the characters of the antennal scale and telson.

Pseudomma Kempi,† sp. n.

This form, like the preceding came to hand after our paper was in proof. The species, in its most obvious characters, very closely resembles *P. calloplura*.

Antennal scale about three times as long as broad, its apex not extending beyond the terminal spine of the external margin. *Eye-plate* hispid, denticulations confined to the antero-lateral margins. *Pleon* with the sixth segment as long as the two preceding taken together. *Telson*, without the terminal spines, about as long as the sixth segment of the pleon; and with the apical spines (about one-sixth of its length) extending to about the extremity of the inner uropods; in shape rather narrowly linguiform, apex sub-truncate, beset with two pairs of rather slender slightly curved naked spines, of which the inner pair is the longer, also with a pair of median denticles, or with a single bifid denticle, and with a pair of plumose setae arising from the dorsal surface a little in front of the denticles; lateral margins, from the level of the hind end of the octoyst, each with about 28-30 spines, increasing in length towards the apex. *Inner uropod* with a single long slender spine at the inner posterior corner of the otocyst. *Length* of adult female, 11 mm.

Our material consists of several females taken in 1901, but overlooked until recently owing to the mislaying of the tube in which they were preserved.

Locality, see p. 145.

* In reference to the plumose spines of the apex of the telson.
† S. W. Kemp.

Genus **Mysideis,** G. O. Sars, 1864.

Mysideis insignis, G. O. Sars.

(?) *Mysidopsis hibernica*, Norman, 1892.

Pl. XXIV., Fig. 5.

Our specimens were at first regarded as examples of *Mysidopsis hibernica*, diverging somewhat from Norman's types in the characters of the telson. Re-examination has shown them to be *Mysideis insignis*, and to this species must also, probably, be referred the imperfect specimen assigned to *M. hibernica* by Holt and Beaumont (1900).

In externally visible characters the description of *M. hibernica* separates that form from *M. insignis* only in regard to the telson, of which the apex shows but a very slight indentation, while no median setae are described. The number and description of the lateral spines, given as "twenty . . . of equal size," would be held by no one as specifically excluding forms in which the number, as in our material, ranges from eighteen to twenty-five, and in which the size of the spines *inter se* is somewhat variable.

In our examples the cleft of the telson, though always more than a mere indentation, is variable in extent, and never very deep. Moreover, the median setae arise from the ventral face of the cleft, so that when they are broken off no trace of them is to be seen from the usual (dorsal) point of view of the observer.

To us it seemed improbable that forms so closely allied by external characters as *M. hibernica* and *M. insignis* could really belong to different genera. We therefore applied to Canon Norman, who, with his usual prompt kindness, re-examined his types and informed us that in the characters of the mouth parts and in the presence of the median setae of the telson *M. hibernica* is a *Mysideis*. He has also sent us his types, the male of which has the pleopods as in *M. insignis*. As he observes, the largest of them is 16 mm., whereas *M. insignis* in Norwegian waters reaches 25 mm. The male type of *M. hibernica*, though fully mature, measures only 15 mm., and our own examples of *M. insignis* do not exceed 20 mm. Unfortunately, some of them got dried up before they were critically examined, and the only mature male sufficiently perfect for comparison in regard to sexual characters measures 16 mm.

While it is possible that *M. hibernica* is a valid species, constantly distinguishable from *M. insignis* by its smaller size and by the absence of a distinct cleft of the telson, we incline strongly to the belief that it is at most a smaller southern race of *M. insignis*, in which the telson may or may not be distinctly cleft. It is worthy of note that Canon Norman took a specimen which he determined as *M. insignis* in the same haul as his types of *M. hibernica*. This, as he tells us, must have been "elsewhere than in its proper place" at the time when he was writing his diagnosis of *M. hibernica*: it agrees with *M. hibernica* except in having a slightly greater emargination of the telson. We have two examples of 9 and 11 mm., of which the first has the telson absolutely devoid of terminal emargination, while the second agrees in this respect with Norman's male type; but another, of 6 mm., has the cleft already well developed. It follows that, if *M. insignis* and *M. hibernica* are to be regarded as synonyms, the condition of the apex of the telson cannot be shown to vary constantly with the size of the individual.

Locality and distribution, see p. 146.

Mysideis (?) Farrani,* sp. n.

This form having been received after our notes had gone to press, only a brief preliminary description can be given here, viz.:—

Body moderately robust. *Carapace* with a very slight obtuse rostrum; only slightly emarginate posteriorly. *Pleon* longer than the carapace, the first five segments subequal, the last segment one and a half times as long as the fifth. *Eyes* large, pigment red. *Antennal* scale lanceolate, about four to five times as long as broad, extending for a little way

* G. P. Farran.

beyond the antennular peduncle, setose all round. *First thoracic legs* with the propodus smaller than carpus, nail distinct, limb generally well armed with plumose setae. *Second thoracic legs* with the merus as long as the carpus and propodus combined, latter shorter than carpus, nail distinct, the limb armed with plumose setae on the last three joints. *Remaining thoracic legs* with the tarsus three-jointed and shorter than the preceding joint, dactylus distinct. *Exopods* of the thoracic limbs well developed, with the outer distal corner of the basal joint rounded, flagelliform part composed of nine joints. *Telson* as long as the sixth segment of the pleon, and two-thirds the length of the inner uropod, gradually tapering to the extremity, which is one-third as wide as the width at the base, apex truncate with a semi-elliptical cleft about one-fifth the length of the telson, the cleft armed with a few very small spines at apex and on sides; extremity of telson on each side of the cleft armed with one short and one long spine, the short spine on the inside; lateral margins of telson with about twenty small spines on the distal two-thirds. *Inner uropod* one and a half times as long as the telson, inner edge armed with about twenty-five spines. *Outer uropod* a little longer than the inner, with setae all round. *Length* of female, 15 mm.

Locality, see p. 146.

In the absence of male specimens it is not possible to refer this species with certainty to the genus *Mysideis*. It appears, indeed, from the characters of the mouth parts, in so far as we have yet studied them, that a new genus may have to be erected for its reception.

Sub-Fam. nov. *ARACHNOMYSINAE.*

Differing from *Leptomysinae* in the absence of an antennal scale.

Genus **Chunomysis**,* n.

Form rather stout. *Carapace* short, gibbous, armed with spines on anterior margin, with a single spine on each lateral margin at the origin of the thoracic part. *Pleon* distinctly arched, its segments armed posteriorly with spines, of which some are upwardly or forwardly directed. *Peduncle of antenna* armed with a spine but destitute of a scale. *Cephalon* not unusually elongate, no perceptible interval between cephalic and thoracic appendages. *Mandibular palp* three-jointed. *Second maxilla* destitute of paragnath. *Telson* short, lamellar, feebly armed. *Incubatory lamellae* of female, two pairs.

The types, two examples of the species which follows, have the antennal flagella broken off at the first joint. Supposing the flagella to be greatly elongate, and the posterior thoracic legs, which are wanting, to be spider-like in character, the genus would differ from *Arachnomysis*, Chun, only in the absence of perceptible interval between the cephalic and thoracic appendages.**

Chunomysis diadema, g. et sp. n.

Pl. XIX., Figs 1—4. Pl. XXV., Figs. 1—7.

Form robust. *Carapace* much wider than pleon, not covering all the thoracic segments; deeply emarginate on its posterior border, anterior border evenly rounded and armed with seven long, slightly depressed, and curved spines, set in the form of a crown. Lateral edges of the carapace bearing at the origin of the thoracic part a short stout and blunt spine. *Eyes* large, reaching to the end of the second joint of the antennular peduncle, their peduncles short, subtriangular in horizontal section. Colour of visual part orange brown after preservation. *Antennular peduncle* about one-quarter the length of the carapace; last joint as long as the preceding two, much stouter and thicker than either of the others. *Antennal peduncle* more slender than the antennular peduncle, and in dorsal view completely hidden by the latter. *Antennae* devoid of scale but armed on the basal joint with a long spine, which reaches nearly to the centre of the last joint of the peduncle.† *Mandible*

* Prof. C. Chun.

** A third specimen recently obtained has the flagella and legs as in *Arachnomysis*.

† A similar spine in place of a scale is found on the antenna of *Arachnomysis Leuckarti*, to which the present species is very closely allied in all its structures.

very strong, palp three-jointed, basal joint the longest, stout, armed on the inner edge with strong setae, a fascicule of which also occurs on the inner distal angle of the joint; next joint smaller and more slender than the first joint, feebly armed with setae; last joint longer than the second but shorter than the first, robust, and strongly armed with numerous setae on the inner edge, which setae are densely plumose. There is one long and strong seta at the tip of the last joint of the palp. Cutting edge not equally developed on both sides, the left side having more teeth than the right. *Maxillae* as in *Arachnomysis*, except that here the paragnath of the second maxilla would appear to be absent (see Chun). *First thoracic limb* very robust and strongly armed, joints short, broad and stout, fifth joint rather more expanded than in *Arachnomysis* and more setose, sixth joint much smaller than fifth. *Second thoracic leg* feeble and slender, basal joint broad and flat, next two small and narrower than basal, merus long and narrow, carpus equal in length to the merus and of similar structure; propodus small; dactylus rather longer than propodus; both the two last-named joints beset with numerous plumose setae.* *Exopodites* of all the thoracic limbs with a spine on the outer distal angle of the basal joint. Flagelliform part composed of eight or nine joints. *Pleon* arched, narrower than the carapace. First five segments subequal, last about equal in length to the preceding two. First five segments armed on their posterior border with spines, some of which are forwardly directed. Sixth segment with the posterior angle of epimera produced into a spine. *Telson* short, feeble, about three-fifths of the length of the last segment of the pleon, and as long as its breadth at the base, lateral margins entire, apex feebly armed with two pairs of short spines, the innermost pair the longer and setiform, but not plumose. *Outer uropods* about two and a half times as long as the telson. *Inner uropods* very little shorter than the outer. Their ventral surfaces naked. Female with two pairs of *incubatory lamellae*, the posterior pair being very large and extending as far as the posterior border of the second segment of the pleon. *Colouration*, of preserved specimens, yellowish brown.

Length, rostral spine to end of telson, 8 mm.

Male unknown, our material consisting of two females.

The short gibbous carapace, and strongly arched pleon give the species a most characteristic appearance. We suppose that the male may have more strongly developed antennular peduncles than the female, furnished, as in *Arachnomysis*, with a profuse brush of setae. The spinulation may probably vary somewhat in individuals, and as between the sexes. In both our examples it is as shown in Fig. 1, but the length of the downwardly curved processes of the anterior margin of the carapace is greater than appears in a dorsal view. Any considerable variation in length in these, and any variation at all in number, is most improbable, while the spine of the lateral edge of the carapace will probably always be found somewhat broader and blunter than in our figure, which makes the spine look a little more slender than in the original.

Variation in the spines of the segments of the pleon is much more probable, since the specific constancy of such structures varies with their abundance. Our specimens have forwardly directed median spines, which rise well above the level of their segments, only on the first two segments. The median spines of the third and fifth segments project boldly, but are not forwardly directed. The occasional occurrence of a median spine on the fourth segment seems probable. The lateral spines on the first five segments are so irregular that we must trust to our figure for their explanation.

The telson is a feeble thing, as in *Euchaetomera*, very thin and flexible, with a pair of median apical processes almost too slender to rank as spines, yet not plumose like the median setae of the *Leptomysinae*.

The two examples were caught in a net fished at the bottom (and thence to the surface), and in the absence of the posterior thoracic limbs, the condition of the telson, which, for some reason obscure to us, seems to be

*A portion of the fifth leg remains, and shows the 'Kegelformige' bristles seen in *Arachnomysis*.

usually stout in bottom mysids, furnishes the only evidence we have of the probably pelagic habitat of the species.
Locality and distribution, see p. 146.

Sub.-fam. nov. *BOREOMYSINAE*.

Outer uropods with their outer margins interrupted and set with a few small spines not far from the base. A more or less distinct suture extending from the point of interruption towards the opposite margin, but not completely dividing the uropod into basal and distal joints.
Female with seven pairs of incubatory lamellae.
Other characters as in *Leptomysinae*, Norman.

Genus **Boreomysis**, G. O. Sars, 1869.

Boreomysis arctica, (Kröyer).

As we record a very considerable extension of range on the evidence of a single small specimen*, it is necessary to note any divergence exhibited by the latter.
Sars' descriptions and figures are taken from specimens of 25 and 27 mm. Ours measures only 10 mm. The front margin of the carapace is rather more widely arched than in the figure of the adult, but the rostral projection is the same, and there is no trace of lateral denticles (such as occur in *B. tridens*). In the lateral armature of the telson the spines show a slightly more marked tendency (as compared with Sars' drawings) towards arrangement in series of several smaller divided by single larger ones, but slight variation in this respect is common. The inner uropods do not appear to have any spines, which is not remarkable having regard to the small size; these spines being of late development in all Mysids which we have had occasion to examine in this regard, and, when their number is small, of rather variable occurrence even in adults.† Other characters being quite satisfactory, there seems to be no risk of a false record. See note, p. 148.
Locality and distribution, see p. 147.

Boreomysis microps, G. O. Sars, 1885.

It may be well to note the one or two minor points in which the single example which we refer to this species differs from the description given by Sars. The antennal scale of our specimen, in other respects exactly as in Sars' figures, projects beyond the antennular peduncle by at least one-third of its length, whereas in Sars' example it projects only by one-quarter of its length. The exopods of the thoracic legs are decidedly larger in our example than Sars' figures would indicate, while the endopods would seem to have a relatively longer dactylus.
B. microps may be distinguished from its congeners by three well-marked characters:
(i.) by the eye, which is small and fusiform in shape, with the cornea not at all expanded and occupying a very small part of the eye.
(ii.) by the last segment of the pleon, which is remarkably elongate and exceeds in length the two preceding segments combined.
(iii.) by the telson, which is unusually slender, and has the edges armed with a series of prominent spines between which are numerous small denticles, the number of the latter between each spine increasing posteriorly. The apical cleft of the telson is small and has a very curious dilation at the top (*vide* Sars, 1885, Pl. xxxiii, fig. 10).
The number of spines on the inner margin of the inner uropods would appear to be two, though it is impossible to be absolutely certain of this point owing to the rather damaged condition of these appendages. The *Challenger* example measured 24 mm., while ours is 21 mm. in length. Both specimens were females, the male being as yet unknown.
Locality and distribution, see p. 148.

* A second, taken while these notes were in proof stage, agrees with the first.

† *e.g.* One of our large *B. tridens* has two on one side, one on the other. This is not due to accident, as the uropod is big enough to show the scar if one spine had been broken off.

PART II.

LOCALITY AND DISTRIBUTION.

The different forms which we have temporarily re-united as Schizopods fall into two main categories, of which one comprises wholly pelagic forms, while the other accounts for those which dwell at or near the bottom. None of them, as one may presume from their form, actually crawl on the bottom like crabs, but some seem to keep as near it as their structure allows, and when we speak of a species as belonging to the bottom we merely intend to imply that it does not, to our belief, make any considerable ascent. The proof of this is most difficult. A horizontal net, which can be opened and closed at a known depth, and fished there with sufficient rapidity to catch such active forms, is not within our experience. Vertical nets, worked through sections of really deep water, act excellently, but in moderately deep water have not scope enough to catch much between particular depths. Serial open tow-nets catch more than any other kind, but the contents of the lower ones are obviously difficult to assign with certainty to particular strata, even when they consist of organisms not met with in the upper nets. Dealing with minute creatures, such as Copepods, which must be caught by any net that comes their way, it is easily discovered that density of distribution varies immensely at times within quite narrow horizontal limits, and much more may this be supposed to be the case with larger and less numerous organisms, which, moreover, possess sufficient activity and perceptive power to make effort to avoid the net. It will be understood, therefore, that our conclusions in regard to vertical distribution are given with considerable reserve, and we may remark that the lists published by the International Bureau show that much more work is required before we can obtain an adequate knowledge of the movements of even well-known shallow water forms. To what extent vertical movements, whether of truly pelagic animals which never touch bottom, or of those which seem normally to live on the bottom, may ultimately prove to depend upon light or darkness, storm or calm, temperature, or factors hitherto untabulated, is still quite uncertain, but in the case of at least one species, Dr. Fowler's work will be found to have made a substantial advance to this end.

We have used the term Atlantic Slope in the title in perhaps too wide a sense, having more regard to the organisms with which we are dealing than to exact physical conditions. Fifty fathoms of water practically eliminate the littoral Mysids, while the *Oceana* and *Research* collecting areas fairly continue those of the *Helga* to the abyss. The actual exploration of the bottom, however, stops for the present at 454 fath., and is confined to the work of the *Helga*, and to such records as are available from the Norwegian coast. The North Sea, though including in its northern part water of considerable depth, we have considered as outside the area of our notes, and we refer to it only in the case of species which have also come under our notice from the outer coast-line of the Atlantic.

In considering horizontal distribution we are not here so much concerned with the general habitat of the truly oceanic forms as with their occurrence on the fringe of their general haunts. We shall therefore attempt no discussion of the various Atlantic "streams" enumerated by Ortmann and others. Much can be said against the retention of such divisions as Norman's "British Area," which, to avoid confusion, we call the "British and Irish Area,"* and it may be supposed that no one uses it except for convenience. But, on the other hand, when it is said that an oceanic form ought not to be classed as British on account of an occasional occurrence near the western coast-line, one is compelled to inquire what reason there is to regard the occurrence as exceptional. Frequently it will be

* We use the term in a compound sense and not in recognition of a separate Irish marine area. The western boundary, which alone concerns these notes, is the 1,000 fath. line.

found that attempts to collect the animal, under circumstances conducive to success, in the off-shore part of the area have been about as infrequent as the captures, and that in fact we have no reason to say that we know anything about the pelagic inhabitants of our coasts, save in the narrow strip of shallow water to which collecting is ordinarily confined. Yet, especially in research dealing with drift-net fisheries, the normal and even the occasional pelagic tenants of the seaward zone have an obvious import.

Turning to bottom forms, such as appear to be the majority of the Mysidae, limited, with due allowance for latitude, to certain depths and to certain conditions of the sea floor, the territorially-named areas have a more apparent reason for existence, since they graphically display the observed limits of range on the shores or slope of the ocean, and since, in the case of a bottom-haunting form, the capture of even a single specimen strongly presumes the normal occurrence of the species in the neighbourhood. Even more than in the case of pelagic forms, breaks in continuity of horizontal record are found to coincide with discontinuity of exploration, so that deduction of factors of distribution based on existing data must necessarily be most tentative.

Questions of temperature, current, drift, &c., are now receiving an attention which has never been bestowed upon them before, and we think it well to defer consideration of these for the present, as they may be more satisfactorily handled when the work has reached a more advanced stage, and in connection with the fauna as a whole, rather than with a particular unit. It may suffice to note that in the case of the bottom Mysids of the Slope the range of temperature from their northern to their southern observed limit seems so wide that except in so far as it may be consistently inimical to less hardy competitors, it does not appear to be a factor of importance. Again, at least off the Irish shore, the upper limit of observed vertical distribution is not marked off from shallower water by any sharp difference. Depths, however, as far as is at present known, seem to present for each species much the same barriers throughout the horizontal range.

Of truly oceanic forms, the following will, by ordinary usage, be admitted to the British and Irish list:—

Euphausia pellucida, West of Ireland* and English Channel (International).
Euphausia similis, English Channel (International).
Euphausia Lanei, sp. n., West of Ireland.
Thysanopoda acutifrons, sp. n., West of Ireland.
Nematobrachion boöpis, West of Ireland.
Thysanoessa gregaria, West of Ireland.
Stylocheiron longicorne, West of Ireland.
Stylocheiron chelifer, West of Ireland.
Gnathophausia zoëa, West of Ireland.
Eucopia australis, West of Ireland.
Katerythrops Oceanae, sp. n., West of Ireland.

Thysanoessa longicaudata and *Nematoscelis megalops* do not appear to have been previously recorded from the Irish part of the Atlantic coast.

Chunomysis diadema is a new species from the West of Ireland, possibly oceanic in range. *Anchialus typicus*, which must be added to the British list on the authority of International records from the Channel, is a species at least in part pelagic and perhaps truly oceanic.

Of apparently bottom-haunting forms the following may be added to the list:—

Meterythrops robusta, West of Ireland.
Meterythrops picta, sp. n., West of Ireland.
Dactylerythrops dactylops, g. et sp. n., West of Ireland.
Hypererythrops serriventer, g. et sp. n., West of Ireland.
Paramblyops rostrata, g. et sp. n., West of Ireland.
Pseudomma roseum, West of Ireland.

*Noted by Holt and Beaumont, 1900.

Pseudomma calloplura, sp. n., West of Ireland
Pseudomma Kempi, sp. n., West of Ireland.
Amblyops abbreviata, West of Ireland.
Mysideis (?) *Farrani*, sp. n., West of Ireland.
Boreomysis arctica, West of Ireland.
Boreomysis tridens, West of Ireland.
Boreomysis megalops, West of Ireland.

The previously known members of this section of the list occur at similar depths in Norwegian waters, and Norman in 1892 predicted that they would be found on our western coasts as soon as the latter were explored.

Gnathophausia drepanephora and *Euchaetomera Fowleri* are new oceanic species, taken respectively in deep water off the West of Ireland (outside the British and Irish area) and to the north of the Bay of Biscay.

Boreomysis microps, a species hitherto known only from a single specimen taken by the *Challenger* at the other side of the Atlantic, and below recorded from the West Coast of Ireland, cannot be added to the British List since the place of capture lies outside the British and Irish area. The circumstances of capture point to its being, at least in part, oceanic.

It may be noted that the following species (of which the first is now added to the Irish list) are shown by the International lists to have occurred at, or over, depths of 50 fath., in localities facing the Atlantic slope without the intervention of land:—

Boreophausia inermis, *Erythrops elegans*, *Erythrops Goesii*, *Leptomysis gracilis*, *Schistomysis ornata*, *Gastrosaccus spinifer*, *Siriella norvegica*, *Siriella crassipes*.

Some of these are common West of Ireland forms, but we have only met with them so far in water of less depth. *Lophogaster typicus*, a deep-water form, is already known on the Slope from Norway to the south of Ireland, and *Schistomysis spiritus*, mostly found in shallower water, has been recorded from more than 50 fath. on our S.W. coast.

Fam. EUPHAUSIIDAE.

Sub-fam. *EUPHAUSINAE*, H. & T.

Genus Euphausia, Dana.

Euphausia pellucida,

Helga.

Inside Porcupine Bank, 175 fath., end of June, 1901, midwater townets at dusk.—Three, 4 to 7 mm.
77 mi. off Achill, 382 fath., August, 1901, tow-net on trawl.—One 11 mm., and (?) one, damaged.
60 mi. off Achill, 199 fath., August, 1901, tow-net on trawl.—Eleven, largest 14 mm. Tow-net on dredge.—Four, 10 to 12 mm.
50 mi. off Tearaght, 320 fath., February, 1903, tow-net at 100 fath.—Four, 7 to 14 mm.
50 mi. off Cleggan Head, 120 fath., July, 1903, tow-net on trawl.—Fragments.
40 mi. off Cleggan Head, 96 fath., August, 1903, bottom tow-net.—One, 7 mm.

Also in several hauls in August, 1904, off the Mayo coast, at depths between 1,000 to 200 and 0 fath.; once in the surface net and in November, 1904, off the Mayo and Kerry coasts, in hauls from 600 and 350 to 0, and in a tow-net on the dredge at 244 fath.

Oceana, November, 1898.

In twenty-four hauls out of a total of thirty which caught schizopods. The hauls were made at from 270 to 1,770 fath., the nets fishing from those depths to the surface. None of the specimens reach the full size of the species.

Research, July, 1900.

The most abundant species in the collection, represented by specimens of 5 to 26 mm., and, we think, by many larvae and ova which we have not examined in such detail as to permit of their being definitely referred to *E. pellucida*.

Dr. Fowler's hauls, carried through twenty-four hours in an admirably methodic manner, only possible, we suspect, under the White Ensign, demonstrate most clearly that this species, in ocean waters, rises at night and sinks by day. The details we may properly reserve for our fuller discussion of his results in *Trans. L. S.* It suffices now to mention that while *E. pellucida* was most abundant at 250 fath. and less, one was certainly taken as low as 750 fath.

Distribution.—Oceanic, in all the oceans, in Mediterranean, but, though known to range as far north as Norway in the Atlantic, not Arctic, nor Antarctic. Evidently of general but not abundant occurrence in that part of the oceanic margin which is honoured by inclusion in the British and Irish area. The International lists, which, up to the present date, contain only one record, viz., from the surface, English Channel, between Plymouth and coast of France, in Feb., 1903,—seem to offer fairly strong evidence that the species rarely if ever penetrates into the North Sea.

Euphausia Lanei, H. & T.

The single specimen occurred in August, 1901, in a tow-net on the trawl at 199 fath., 60 mi. off Achill—a circumstance which affords no clue to the normal habitat of an apparently oceanic form.

The International lists contain a record of the occurrence of *E. similis*, at the surface, off Scilly, in February or March, 1903. It is a form obviously distinct from *E. Lanei*, and is previously known from the South Atlantic, S.E. of Buenos Ayres (*Challenger*), off the Cape of Good Hope (Schott), and off N. Brazil (Ortmann). The circumstances of capture recorded by Schott and Ortmann indicate that it belongs to the upper strata of the ocean.

Genus Thysanopoda, M.-Ed.

Thysanopoda microphthalma (?) G. O. Sars, 1885.

Research.

An advanced larva, probably referable to this species, occurs in a gathering made between 100 fath. and surface.

Distribution.—Sargasso Sea and Tropical N. Atlantic (*Challenger*), Indian Ocean (Wood Mason), Greenland Seas (Ortmann), and Faroë Channel (Fowler). The species is apparently widely distributed throughout the North Atlantic Ocean.

Thysanopoda acutifrons, H. & T.

Helga.

50 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, 1,000+fath., August, 1904, large tow-net, 1,000 to 0 fath.—Five, 9 to 14 mm.

40 mi. same course, 750 fath. Same date and net, 750 to 0 fath.—Twelve, 10 to 14 mm.

Same position and depth, November, 1904, large tow-net, 600 fath.—Six, 14 to 22 mm.

Genus Nyctiphanes, G. O. Sars, 1883.

Nyctiphanes Couchi (Bell).

This is one of the few N.E. Atlantic representatives of the family which, though essentially pelagic, appear to be non-oceanic. The deepest water in or over which we have taken it is 300 fathoms, off the coast of

Mayo, from which depth a tow-net attached to the trawl-head lifted a single specimen. There were none in the nets on the "back" of the trawl net, which probably catch only benthic species; so, if our *Nyctiphanes* came from the bottom on that occasion, members of its species were certainly not abundant there. Without recapitulating a long list of captures, it may suffice to say that *N. Couchi* is frequently brought to hand on the W. coast of Ireland from water of less than 100 fathoms deep. Nets, except huge coarse-mesh tow-nets, fished at night, it is skilled to avoid, but during the spring and early summer it may constantly be found in the stomachs of sea-trout taken at night in surface drift-nets on the Cleggan fishing-grounds, and in so fresh condition that it must certainly be common at night at or near the surface at depths which often do not exceed 20 fathoms. It is in fact a creature of the coast, rather than of the oceanic slope, but cannot be altogether excluded from the Fauna of the latter.

Often taken with the young of *M. norvegica*, we have never found it in company with examples of the latter exceeding 30 mm. Occasionally we have found it, in surface hauls made at night, in company with *Thysanoessa neglecta*. Its breeding period, as evidenced by the ovigerous females which have fallen into our hands, is in the spring and summer months.

Distribution.—Paucity of record is, we imagine, largely due to failure to distinguish this species from *M. norvegica*, but such surmise does not account for its absence from the Norwegian list, as Sars would certainly have noted it had it occurred in Norse waters. It is known from the Firth of Tay and from the coast of Denmark in the North Sea, and must certainly occur in other parts of that region. Its occurrence on the W. coast of Scotland is not recorded, but may be presumed. We have seen that it is common on the W. coast of Ireland. It occurs in the Irish Sea and at least in the western part of the English Channel, both at sea and within Plymouth Sound. We know of no record from the Atlantic coast south of the Channel, but the Euphausians of that region do not seem to have been much studied. It would seem to be absent from the Mediterranean.

GENUS **Meganyctiphanes**, H. & T.

Meganyctiphanes norvegica (M. Sars).

Previous records, with such as we are able to add, seem to warrant the generalisation that this species, though going far to sea and penetrating to depths of some hundreds of fathoms, is not truly oceanic. Though it occurs on both sides of the North Atlantic, it does not seem to have been recorded from the central parts nor from the Arctic fringe of this area.

Fowler considers that in its adult condition it is not a surface form, and this contention is not disturbed by any material which we have examined.

Tolerant of a very considerable range of temperature, it seems unable to exist at a depth of more than 500 fath., whether from considerations of pressure or lack of suitable food; while it thrives at less than 100 fath. on the W. of Scotland, and is at times abundant near the E. coast of Ireland at 60 to about 20 fath. At such small and moderate depths adults, and probably all stages, spend at least a part of their time actually at the bottom, but where the species sets seawards from the Atlantic slope it becomes purely pelagic. Whether the individual found far at sea over several thousand fathoms of water ever again returns to suitable soundings is a question that we have no present means of solving, but from a comparison of sizes we are inclined to suspect that the off-shore shoals are recruited from the neighbourhood of the land.

The lists published by the International Bureau include a number of records of the species, on which we have drawn for our summary of distribution. No mention is made of the size of individuals, and of their

vertical distribution; it is only possible to say that while captures were made at the surface and in the upper strata, none were made under circumstances which prove the species to have been actually at the bottom.

As compared with *N. Couchi*, *Meganyctiphanes* is, on our western coast, a more seaward form. Its occurrence, even in the young condition, on the Cleggan fishing grounds is not frequent, and may sometimes, by the presence of salps and the like, be clearly associated with a general inward movement of ocean water. In particular its absence from the menu of the sea-trout, an enthusiastic student of the coastal *Euphausiidae*, serves to demonstrate its general exclusion from the immediate neighbourhood of land on this coast.

The following list enumerates the occurrences of *M. norvegica* in the nets of the *Helga* and *Monica* on the west coast of Ireland. They are arranged roughly in the order of remoteness from nearest land.

Porcupine Bank, 91 fath., end of June, 1901, tow-net on dredge and bottom tow-net.—Twenty larvae, 4 to 8 mm., several young, 10 to 17 mm.

Inside Porcupine Bank, 120 fath., same date, tow-net on dredge.—Seven larvae, sixty young, 7 to 16 mm.

Inside Porcupine Bank, 175 fath., same date, at dusk, bottom tow-net.—One young, 12 mm. Midwater tow-net.—Sixteen young, 7 to 12 mm. Surface tow-net.—Two young, 18 and 20 mm.

60 mi. W. of Achill Head, end of August, 1901, 199 fath., tow-nets on trawl-beam and dredge.—Over eighty, 11 to 23 mm.

50 mi. W. of Cleggan Head, Co. Galway, 116 to 120 fath.
August, 1902, bottom tow-net.—One.
July, 1903, bottom tow-net.—Number not recorded.
,, ,, tow-net on trawl.—Thirty.
,, ,, tow-net on trawl.—Four, 11 mm., one, 26 mm.

40 mi. W. of Cleggan Head, 90 fath., bottom tow-net.—Three.

30 mi. W. of Cleggan Head, 72½ fath., July, 1903, tow-net at 60 fath.—Twelve. Midwater tow-net.—Two.

20 mi. W. of Cleggan Head, 72½ fath., July, 1903, surface tow-net.—One.

40 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, 750 fath., August, 1904, surface net.—Thirty-six.*

About 15 mi. from Inisbofin and Achill, about 70 fath., May, 1904, 6 ft. triangular net at night, between 15 fath. and surface.—Many, 19 to 30 mm.

About 5 mi. W.S.W. of Shark (an island of the Inisbofin group), July, 1903, about 60 fath., tow-net.—Many, 4 to 10 mm.

Cleggan mackerel ground, outside and about Inisbofin and neighbouring islands, about 20 to 50 fath.—taken on several occasions, viz.:—

Tow-nets, July, 1900 and 1901.—Small specimens.
August, 1903.—Six, 10 mm., eighteen, 11 mm.
October, 1903.—Few, small.
September, 1900 and 1902.—Few, small.

Stomachs of mackerel, herring, and gurnard. Occasionally in February to May, and in August, 1902 and 1903.

Cleggan Bay and immediately seawards, about 5 to 15 fath., tow-nets.—A few, small, in October and November, 1903.

Some gatherings yet remain to be examined, but none which can seriously affect the evidence offered by the above list. All the tow-nets mentioned are open nets and may have taken their catch either at the depth to which they were sunk or on their way to the surface, except in the case of "tow-nets on trawl" (not trawl-beam). These, we think, do not fish except when the trawl is on the ground, as at other times they lie against the net and have little chance of catching anything. It follows that the list comprises only two captures, both at about 120 fath., 50

* There are also some deep-water records for November, 1904, off the coasts of Mayo and Kerry, but the gatherings are not yet completely sorted.

miles off land, which seem to have been certainly made at the bottom. At the 199 fath. station, where numerous specimens were found in tow-nets on trawl-beam and dredge-bridles, none got into the nets on the "back" of the trawl, so the species cannot have been abundant actually on the bottom. However, near the same place, Holt and Beaumont found a number in the stomach of *Pristiurus melanostoma* at 154 fath. *Pristiurus* is, one may suppose, a ground-feeding fish. These last were specimens of fair size, as are those taken in the big triangular net at night in May, 1904, whereas all others mentioned in the above list are small, or at least short of the full size.* The probable explanation is that the species, when large, is too agile for ordinary tow-nets, especially in the day time, and did not happen to be on the ground worked by the trawl. There is only a single record from the surface tow-net worked during daylight.

The *Oceana*, working towards the 1,000 fath. line off the S.W. of Ireland in November, encountered the species in one haul only, viz., in a tow-net fished at 650 fath., and thence to the surface (52°45′5″ N.; 12°27′ W.). None were found in the more westerly gatherings.

The *Research* in July in the N. part of the Bay of Biscay, with soundings of 1,219 to 2,341 fath., took the species in considerable numbers from 19 to 35 mm. in length, but only at night, and only in the upper 100 fathoms, though not, with certainty, at less than 25 fath. from the surface. What became of it during the day time is hard to say, unless it remained near the surface and saw the nets well enough to dodge them.

Distribution.—N. Siberia, Spitzbergen, Jan Mayen, Greenland, Coast of Norway, Faröe Channel, Shetland, Orkney, E. and W. of Scotland, N. of North Sea, Skagerack, Kattegat, Ireland (but not yet observed on S.E.), Bay of Biscay, Portugal, N.E. America.

GENUS **Boreophausia**, G. O. Sars.

Boreophausia inermis (Kröyer).

Though not previously recorded from Irish waters, we have taken this species frequently at various points on the west coast, but not at or above any depth greatly exceeding 50 fath. It is at times an important food of mackerel, herring, and sea trout on this coast. We have also taken it in the Irish Sea.

Distribution.—Greenland, Norway, Faröe Channel, N., E. and W. of Scotland, English Channel, N.E. America.

We can find no record which definitely assigns *B. inermis* to a deep-water habitat, but it is mentioned in the International lists from a net worked between about 750 fath. and the surface. It seems probable that it occurs, when found at any considerable distance from the shore, only in the upper strata.

SUB-FAM. *NEMATOSCELINAE*, H. & T.

GENUS **Thysanoessa**, Brandt.

Thysanoessa neglecta (Kröyer).

T. borealis, G. O. Sars, 1882.

Though ranging far to sea and over considerable depths, this is not an oceanic species and is not represented in the collections of the *Oceana* and *Research*.

In the *Helga* collections on off-shore grounds its seaward limits are represented by captures at 199 fath., 60 mi. off Achill, and 120 fath., 50 miles off Cleggan Head. It occurs in *Helga* gatherings at 40, 30, and 20 miles off Cleggan Head, and is fairly common in the *Monica* tow-nets

* This applies to, *inter alia*, specimens of which we have not given dimensions in the list.

from the mackerel grounds, practically at all seasons of the year, but most commonly in winter, and ranges at times into coastal waters of quite inconsiderable depth. We know of its occurrence at the surface only from hauls made at night, and during daylight it seems to frequent the bottom or its neighbourhood.

It may be classed as one of the occasionally important items in the food of the mackerel, and is also captured by the spur dog (*Acanthias vulgaris*).

In general the habitat on the Irish coast presents a close affinity to that of *Nyctiphanes Couchi*, but, from the evidence of tow-nets and fish-stomachs, the two forms do not consort together to any great extent.

Distribution.—Norway, from Finmark South; in deep water off the Norwegian coast in the upper strata, Faröe Channel (upper strata), Shetland, Skagerack, parts of the Irish and Scottish coasts, north part of North Sea, Bay of Biscay, N.E. America.

We do not know of a record from the southern part of the North Sea, English Channel, St. George's Channel, or Irish Sea. Caullery's deep water record from the Bay of Biscay is based on mangled specimens and requires confirmation.

Thysanoessa longicaudata (Kröyer).

T. tenera, G. O. Sars, 1882.

Helga.

Porcupine Bank, 91 fath., end of June, 1901, bottom tow-net.—Eighteen, 5 to 8 mm., one about 12 mm.*

Inner edge of Porcupine Bank, 120 fath., June, 1901, tow-net on dredge.—Five larvae (presumably of this species).

Inside Porcupine Bank, 175 fath., end of June, 1901, mid-water tow-nets, at dusk.—Seventeen, 8 to 11 mm.

77 miles off Achill, 382 fath., August, 1901, tow-nets on trawl.—Eight, 8 to 10 mm.

60 miles off Achill, 199 fath., August, 1901, tow-nets on dredge.—Three 9 mm., one 10 mm.

30 miles off Tearaght, *ca.* 120 fath., tow-net at 20 fath.—One.

50 miles of Tearaght, Co. Kerry, November, 1904, large tow-net, 350 fath.—Seven, 9 mm.

48 miles off Tearaght, November, 1904, tow-net on trawl, 337 fath.—One, 9 mm.

50 miles N. by W. (Magn.) of Eagle Island, Co. Mayo, 1,000+fath., August, 1904, tow-net 1,000 to 0 fath.—Fourteen.

40 miles same course and date, 750 fath., tow-net 750 to 0 fath.—Twenty.

Also in August, 1904, in tow-nets on trawl, at 112 and 180 fath., off Co. Galway.—Ten and three

Oceana.

The most abundant in number of all forms taken by the *Oceana*, but exceeded in prevalence in hauls by *E. pellucida* and *S. longicorne*, which each occur in twenty-four hauls, to twenty in which *T. longicaudata* is represented. The nets in which it was taken were fished at 500 to 1,770 fath., and from those depths to the surface. It seems to have been absent from the upper strata, since nets fished at depths of 270 to 500 fath. caught other schizopods.

Distribution.—Occasionally taken in company with other northern forms on the British coast of the North Sea, this species is better known from the Northern and Arctic parts of the Atlantic from Europe across to the warm water of the "Gulf-stream." It is, therefore, a truly oceanic species of the North and Arctic Atlantic. Fowler (1903), who has given a rather full account of its then known distribution, says it has "no more right to be regarded as a 'British' species than an occasional *Velella* or

*This is the only specimen which we have seen with the slight acumination over telson mentioned in our diagnosis (see p. 107). The elongate limb happens to be present and is as in *T. tenera*.

Ianthina brought up by the North Atlantic drift to our shores." With this we agree, since the ocean has no politics, but the *Helga* and *Oceana* records show that the southern extension of its range is very considerable, and suggest, from the several years over which the records are spread, that it is a normal range and not, on the occasion of each capture, due to some exceptional circumstances of drift.

The International lists give, up to Feb., 1904, only a few records, of which the most southerly is from the northern part of the North Sea. The species occurred chiefly at the surface, or in upper strata.

We have remarked, in the systematic part of our notes, on the differences which appear to exist between Irish and Norwegian examples. Further work may demonstrate a limit of range and character between northern and southern forms.

The *Oceana* records, as we have seen, apparently eliminate the species from the upper waters during the period of the cruise. The *Helga* records, limited to comparatively shallow waters, present occurrences of the species at or above mid-water (soundings 175 fath.), and at or above 20 fath. (soundings 120 fath.), but the surface nets took none, even at night. An oceanic form, fringing on the margin, must necessarily be found at depths which do not harmonise with its ordinary haunt over the abyss to which it properly belongs.

Thysanoessa gregaria, G. O. Sars.

The small specimens, which we have referred with some remark (see p. 108) to this species, were taken by the *Oceana* on either side of the 1,000 fath. line in nets fished at from 500 to 1,710 fath., and from those depths to the surface.

The *Research* collections comprise four larvae, apparently referable to this species, taken between 100 and 75 fath. and the surface.

Distribution.—Oceanic, North, Equatorial, and South Atlantic; Mediterranean; Pacific, Japan to Australia.

Genus Nematoscelis, G. O. Sars.

Nematoscelis megalops, G. O. Sars.

Helga.

Inside the Porcupine Bank, 175 fath., end of June, 1901, mid-water tow-net.—One, 14 mm.

50 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, August, 1904, 1,000+fath., large tow-net 1,000 to 0 fath.—Two.

40 mi. same course and date, 750 fath., same net, 750 to 0 fath.—Two.

81 mi. W. of Eagle Island, Co. Mayo, 220 fath., August, 1904, tow-nets on trawl.—One.

40 mi. N. by W. of Eagle Island, Co. Mayo, November, 1904, large tow-net, 600 fath.—Five, 14 to 18 mm., Twelve, 7 mm.

Research.

Rather abundant, especially at night, in nets hauled from 100 fathoms and less to the surface. It appears, but it is not with certainty shown, to rise at night, but only one was taken in an actual surface net. Its deepest occurrence is between 400 and 300 fath., if some mangled specimens have been rightly named by us. Proceeding upwards we next find it in a net hauled between 150 and 50 fath., during the day time.

Distribution.—Apparently oceanic, occurring in both North and South Atlantic. Though taken on the coast of Great Britain, as well as on the Irish slope, the rarity of its observation on the latter, in spite of fairly assiduous netting, suggests that it does not normally approach our shores. We have, however, taken it in the Irish Sea on one occasion. The northern limit of its range appears to be the Irming Sea between Greenland and Iceland. Southwards it is not known from beyond the subtropical region

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Genus **Nematobrachion**, Calman.

Nematobrachion boöpis (Calman).

Helga.

50 mi. N. by W. of Eagle Island, Co. Mayo, 1,000+fath., August, 1904, tow-net 1,000 to 0 fath.—Three.

40 mi. same course and date, 750 fath., tow-net 750 to 0 fath.—Two.

50 mi. W. of Tearaght, 237 fath., August, 1904, bottom tow-net.—One.

40 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, November, 1904, large tow-net, 600 fath.—Three, 11 to 18 mm.

Research.

One specimen in each of seven hauls, of which all but two were carried to the surface. Two specimens are demonstrated to have occurred between 500 and 250, and between 250 and 150 fath. respectively. One was in 100 fath. or less. Another may have been anywhere between 1,250 and 0; the remainder between 350 to 250 and 0 fath.

Distribution.—Otherwise known only from a single specimen taken in an open net at 1,020 fath. off the S.W. coast of Ireland. Evidently oceanic, and not at all likely to be restricted to the small part of the N. Atlantic from which it is at present known.

Genus **Stylocheiron**, G. O. Sars.

Stylocheiron longicorne, G. O. Sars.

S. mastigophorum, Chun, 1888.

Helga.

60 mi. off Achill, 199 fath., August, 1901, tow-net on trawl.—Two adult.

50 mi. off Tearaght, 320 fath., February, 1903. Tow-net at 50 fath. —One, 5 mm.

50 mi. off Tearaght, Co. Kerry, November, 1904. large tow-net, 350 fath.—Six, 6 to 9 mm.

40 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, November, 1904. large tow-net, 600 fath.—One. 15 mm.

Also in August, 1904, 200 fath., off Co. Galway, in tow-net from bottom to surface.—One.

Oceana.

In twenty-four out of thirty hauls, in open tow-nets, fished at depths of from 270 to 1,770 fath., and thence to surface. Occurs in stations on either side of the 1,000 fath. line.

Research.

Of very frequent occurrence in hauls between 100 fath. or less and surface, but cannot be definitely referred to any depth greater than 50 fath., though some of the nets in which it was taken started their course much deeper. Only taken actually at the surface at night.

Distribution.—Oceanic, apparently of the upper strata. North and South Atlantic, not known from north of a line drawn from the north of Ireland to the United States, but extending as far south as the Cape of Good Hope. Mediterranean.

Though apparently abundant over deep water west and south west of Ireland and in the Bay of Biscay, absence from the International lists seems to show that it does not range further towards the north-eastern coast of Europe.

Stylocheiron chelifer, Chun.

? *S. abbreviatum*, G. O. Sars.

Helga.

40 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, November, 1904, large tow-net, 600 fath.—One, 15 mm.

Oceana.

In a net fished at 1,410 fath., and thence to the surface, in lat. 52° 18′ 1″ N., long. 15° 53′ 9″ W.—One, very large.

Research.

In seven hauls, between 100 to 75 fath. and surface, in the Bay of Biscay.

Distribution.—Oceanic, apparently in the upper strata. North Atlantic and Mediterranean, and if, as we suppose, identical with *S. abbreviatum*, Sars, South Atlantic and Pacific. Ireland to the subtropical region seems to be the extent of its known Atlantic range from north to south.

Sub.-fam. *BENTHEUPHAUSINAE*, H. & T.

Genus Bentheuphausia, G. O. Sars.

Bentheuphausia sp. (?)

Research.

A single mutilated specimen in a haul between 1,250 fath. and surface.

Distribution.—*B. amblyops*, though known from very few specimens, appears to range through the oceans. Though almost certainly exclusible from the fauna of the upper strata, there is nothing to show its precise vertical habitat.

Fam. LOPHOGASTRIDAE.

Genus Lophogaster, M. Sars.

Lophogaster typicus, M. Sars.

Helga.

50 mi. W. of Cleggan Head, 120 fath., *ca.*, August, 1903, tow-net on trawl.—One.

Distribution.—Atlantic, Norway to Cape of Good Hope; Mediterranean.

Genus Gnathophausia, Willemoes Suhm, 1875.

Gnathophausia zoëa, Willemoes Suhm, 1875.

Gnathophausia zoëa, G. O. Sars, 1885.

Helga.

77 mi. off Achill, 382 fath., August, 1901, tow-net on trawl-head.—Two, 25 and 38 mm.

40 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, November, 1904, large tow-net, 600 fath.—Two, 26 mm.

Distribution.—Oceanic, in North and Tropical Atlantic, and in South Pacific; known from a few *Challenger* records from open nets fished at depths from 660 to 1,850 fathoms, and fishing to the surface.

Our specimens, far short of the full size, show that the species ranges, at least at times, into comparatively shallow water. So large a form, even if numerous, is likely to evade tabulation by the nets which can ordinarily be used in deep-water work.

Gnathophausia drepanephora, H. & T.

Oceana, Lat. 52° 27′ 6″ N., Long. 15° 40′ W.

The only known specimen was taken in a net fished at 1,770 fath., and thence to the surface.

Fam. EUCOPIIDAE, G. O. Sars.

Genus Eucopia, Dana.

Eucopia australis, Dana.

Helga.

77 mi. off Achill, 382 fath., August, 1901, tow-net on trawl.—One, 19 mm.

50 mi. N.W. by N. of Eagle Island, Co. Mayo, 1,000+fath., August, 1904, tow-net 1,000 to 0 fath.—One.

40 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, November, 1904, large tow-net, 600 fath.—Five, 25 mm.

Oceana.

In three hauls at depths from 500 to 1,710 fath., and thence to surface. None of the specimens are of full size.

Research.

In six hauls, from which it appears that the species was taken at least as low as 750, and at least as high as 200 fathoms. Probably 100 to 1,000 fath. include the strata in which it occurred, with some margin each way. One example, represented by fragments, may have been nearly full-grown. The rest are small.

Distribution.—Oceanic, in all the oceans; Antarctic, but not so far recorded as Arctic. Possibly ranging to 2,500 fath., its vertical distribution cannot with certainty be extended beyond the limits ascertained by the *Research*. Evidently not a surface form.

The material which we have taken or received has always been preserved in formaline, a medium which suits other schizopods well enough even for considerable periods. Eucopia, however, has such a flimsy integument that, if specimens suitable for museum purposes are desired, it should be hardened as soon as taken.

Fam. MYSIDAE.

Sub-fam. *LEPTOMYSINAE*, Norman.

Genus Erythrops, G. O. Sars.

Erythrops serrata, G. O. Sars.

Helga.

60 mi. off Achill, 199 fath., August, 1901; very numerous both in tow-net on trawl with sand and in tow-net on dredge, 5 to 10 mm.

Also taken on several occasions at 50 mi. off Cleggan Head, 116 to 220 fath.

Distribution.—Norway, West Finmark to Christiania Fjord, 30 to 200 fath.; coasts of Scotland and Ireland; Denmark.

This seems to be a bottom species. Though perhaps properly belonging to the Atlantic slope, it is by no means confined thereto, ranging into the North Sea and occurring abundantly in the Irish Sea. So far as we are aware there is no record which proves its capture except at or in the immediate neighbourhood of the bottom. It is only mentioned in the International lists from a capture between bottom and surface.

Genus Meterythrops, S. I. Smith, 1879.

Meterythrops robusta, S. I. Smith, 1879.

Parerythrops robusta, G. O. Sars, 1879.

Helga.

60 mi. off Achill, 199 fath., August, 1901, tow-net on trawl, with sand.—Six, not full grown.

Distribution.—Norway—East Finmark, and Lofoten only; N.E. America, 60 to 150 fath.; Kara Sea, Spitzbergen, and Greenland.

Our record extends the vertical as well as the horizontal range, and the circumstances of capture assign the species to the bottom. The absence from Sars' gatherings in the more southern waters of the Norwegian coasts may be due to its large size and presumable activity, though forms at least as large were taken.

Meterythrops picta, H. & T.

Helga.

77 mi. off Achill, 382 fath., August, 1901, tow-net on trawl-head.—One, 13 mm., immature male.

Presumably a bottom species, but not proved to be so by circumstances of capture.

Genus Katerythrops, H. & T.

Katerythrops Oceanae, H. & T.

Oceana.

Lat. 52° 27′ 6″ N., Long. 15° 40′ W., in a net fishing at 1,470 fathoms, and thence to surface.—One.

Lat. 52° 20′ N., Long. 15° 7′ 9″ W., in a net fishing at 560 fathoms, and thence to surface.—One.

Distribution.—Evidently one of the few known pelagic Mysids, and, from its absence from the *Helga* collections, probably oceanic. The *Oceana* gatherings, made with open tow-nets, prove only that it was taken at least as far from the bottom (over 1,700 fath.) as the records show. The absence of all schizopods from nets fished at less than 270 fath. seems capable of an explanation not complimentary to the efficiency of the nets.

Genus Dactylerythrops, H. & T.

Dactylerythrops dactylops, H. & T.

Helga.

77 mi. off Achill, 382 fath., August, 1901, tow-net on trawl-head.—Two, male and female.

60 mi. off Achill, 199 fath., August, 1901, tow-net on dredge.—One male.

It is perhaps significant that no specimens were detected in the sandy gathering from "back" of trawl at 199 fath., nor at 382 fath., except in the tow-net on trawl-head, which is of course in front of the ground-rope, and only assisted, if at all, in the capture of bottom forms by the disturbance caused by the trawl bridles. The species was, however, certainly rare on the ground traversed, and may well have been represented in the sandy gatherings by some of the unrecognisable fragments which formed a large proportion of the latter.

We regard it as a bottom species, but have evidently not happened on its local centre of distribution.

Genus **Hypererythrops**, H. & T.

Hypererythrops serriventer, H. & T.

Helga.

60 mi. off Achill, 199 fath., August, 1901, tow-nets on trawl and dredge.—About twenty, 5 to 10 mm.

40 mi. off Tearaght, Co. Kerry, November, 1904, 244 fath., tow-net on dredge.—Four, 6 to 9 mm.

Several were in the tow-net of sand on "back" of trawl, but more in the tow-net on dredge. Apparently a bottom species.

Genus **Parerythrops**, G. O. Sars.

Parerythrops obesa, G. O. Sars.

Helga.

60 mi. off Achill, 199 fath., August, 1901, tow-net on dredge.—Four, 7 to 10 mm. *ca.*

40 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, 670 fath., November, 1904, large tow-net, 600 fath.—One, 5 mm.

Distribution.—Norway, West Finmark to Christiania Fjord, 50 to 250 fath.; S.W. of Ireland (off the Skelligs), 52 to 62 fath., a single specimen, rather imperfect (Holt and Beaumont).

If chiefly a bottom form, we have not found it in recognisable condition in the large gathering made by tow-nets on the trawl back at 199 fath., fished at the same time as the dredge. It cannot, therefore, have been very abundant on the ground at the time, and, though shown to extend southwards, its absence from a number of hauls with suitable apparatus and at apparently suitable soundings, suggests that it is not a common form on the Irish part of the Atlantic slope. The 600 fath. net was never within less than 70 fath. of the bottom.

Genus **Euchaetomera**, G. O. Sars, 1885.

Euchaetomera Fowleri, H. & T.

Research.

An adult male and female in two hauls from 250 and 200 fath., respectively, to the surface in the Bay of Biscay.

Obviously pelagic and oceanic, the species is only known from the above record. Its nearest relative, *E. tenuis*, is a Pacific form.

Genus **Amblyops**, G. O. Sars.

Amblyops abbreviata, G. O. Sars.

Helga.

48 mi. off Tearaght, 337 fath., November, 1904, tow-net on trawl.—Twelve, 12 to 15 mm.

54 mi. off Tearaght, 454 fath., November, 1904, tow-net on trawl.—Two, 15 mm.

Distribution.—Norway—Lofoten to Christiania Fjord, 100-300 fath.

Genus **Paramblyops**, H. & T.

Paramblyops rostrata, H. & T.

Helga.

77 mi. off Achill Head, 382 fath., August, 1901, tow-net on trawl.—One.

60 mi. off Achill, 199 fath., August, 1901, tow-nets on trawl and dredge.—About seventy, 9 to 10 mm., and many fragments.

81 mi. W. ½ N. Eagle Island, Co. Mayo, August, 1904, 220 fath., tow-nets on trawl.—One, 7 mm.

40 mi. off Tearaght, Co. Kerry, November, 1904, 244 fath., tow-net on dredge.—Eight, 6 to 8 mm.

Near last, 337 fath., November, 1904, tow-net on trawl.—One, 6 mm. Most of these were found in the tow-net of sand from the "back" of the trawl. It is evidently a bottom species.

Also taken in August, 1904, in tow-net on trawl at 220 fath., off Co. Galway, and 75 mi. off Fastnet, 181 fath., May, 1904.

Genus **Pseudomma**, G. O. Sars.

Pseudomma roseum, G. O. Sars.

Helga.

60 mi. off Achill, 199 fath., August, 1901, tow-nets on trawl and dredge.—Over a hundred, 5 to 11 mm.

50 mi. off Cleggan Head, 120 fath., July, 1903, mosquito-net on trawl.—Two, 5 and 7 mm. One adult, fragmentary.

40 mi. off Tearaght, Co. Kerry, November, 1904, 244 fath., tow-net on dredge.—Thirteen, 6 to 9 mm.

Distribution.—Norway, from extreme north (W. Finmark) to south, 100 to 450 fath. North America, Nova Zembla, West Greenland seas. Definitely relegated by its occurrence in numbers in sand in the Achill trawl tow-net to a bottom habitat, the species may be expected to extend along the Atlantic slope to a point considerably south of Ireland. An International record from the coast of Norway mentions it in a net which was fished from about three fathoms off the bottom upwards.

Pseudomma calloplura, H. & T.

Helga.

77 mi. off Achill Head, 382 fath., August, 1901, tow-net on trawl.—One.

60 mi. off Achill Head, 199 fath., August, 1901, tow-net on dredge.—Eight; tow-net on trawl.—Four.

48 mi. off Tearaght, 337 fath., November, 1904, tow-net on trawl.—Eight, 6 to 10 mm.

40 m. off Tearaght, 244 fath., November, 1904, tow-net on dredge.—Twelve, 6 to 10 mm.

Pseudomma Kempi, H. & T.

Helga.

77 mi. off Achill Head, 382 fath., August, 1901, tow-net on trawl.—Seven.

Genus **Mysidopsis**, G. O. Sars.

Mysidopsis didelphys, Norman.

Helga.

60 mi. off Achill, 199 fath., August, 1901, tow-net on trawl.—Over thirty, 7 to 13 mm. Tow-net on dredge. Twenty-two, 6 to 12 mm.

50 mi. off Cleggan Head, 120 fath., July, 1903, tow-net on trawl.—Two.

Off Co. Galway, 112 fath., August, 1904, tow-net on trawl.—Three.

Distribution.—Norway (from Lofoten southwards), 30 to 150 fath.; Denmark; Shetland; east and west coasts of Scotland; north-east coast of England; west coast of Ireland.

Our specimens from the tow-net on trawl off Achill were mixed up with sand and must have come from the bottom. A capture at 62 to 52 fath. off the Skelligs, Co. Kerry, in 1890, was, almost certainly, also effected at the bottom.

The species seems therefore to range on our western coast from about 50 to about 200 fathoms, and we know of no record to prove that it ever leaves the neighbourhood of the bottom.* Its occurrence, however, in the North Sea and at so small a depth as 30 fath. in Norway, seems to mark it as a form not essentially belonging to the Atlantic slope, and susceptible, by means of suitable methods of observation, of reference to a considerably greater range than that which can at present be assigned to it.

GENUS **Mysideis**, G. O. SARS.

Mysideis (?) **Farrani**, H. & T.

Helga.

54 mi. off Tearaght, 454 fath., November, 1904, tow-net on trawl.—Nine, 10 to 15 mm.

48 mi. off Tearaght, 337 fath., November, 1904, tow-net on trawl.—Three, 12 mm.

Mysideis insignis, G. O. SARS.

Helga.

60 mi. off Achill, 199 fath., August, 1901, tow-net on dredge.—One, 6 mm., one, 12 mm., five, about 15 to 20 mm.

40 mi. off Tearaght, Co. Kerry, November, 1904, 244 fath., tow-net on dredge.—One, 9 mm.

Distribution.—Norway,—West Finmark to Christianiafjord, 100-300 fath.; S.W. Ireland,—Off Skelligs, 62-52 fath.; off Valentia, 112 fath. (Norman *in litt.*).

The dredge to which the *Helga* tow-net was attached presented no certain evidence of having been actually on the bottom, though it probably was for part of the time. The species does not appear among those taken at the same time in the tow-nets on the trawl, so there is no absolute certainty of its vertical locus of capture. We regard it, however, as a bottom species.

SUB-FAM. *ARACHNOMYSINAE*, H. & T.

GENUS **Chunomysis**, H. & T.

Chunomysis diadema, H. & T.

Helga.

77 mi. off Achill, 382 fath., August, 1901, tow-net on trawl-head.—Two adult females, not ovigerous.

Our specimens are too imperfect in the matter of legs and antennae to admit of comparison with the obviously pelagic *Arachnomysis*, but the feeble lamellar telson is such as is not known to us in any Mysid which can definitely be referred to a bottom habitat. The circumstances of capture, on the trawl-head, are quite different from those which we suppose to obtain in captures in nets on the trawl (*i.e.*, on the "back" of the trawl net), and do not preclude capture above the bottom.

We think this is a pelagic species of the ocean, but perhaps not of the highest strata. Wandering into the comparatively shallow area of the coast, it may well have been taken at or near the bottom. Our captures of such non-benthic forms as *Euphausia pellucida* and *Stylocheiron longicorne* in bottom nets on the Slope present the necessary illustration.

* An International record, between Shetland and Orkney, proves its occurrence at least two and a half fathoms from the bottom.

SUB-FAM. *GASTROSACCINAE*, Norman.

GENUS **Haplostylus**, Kossmann.

Haplostylus Normani (G. O. Sars).

Helga.

Porcupine Bank, 91 fath., end of June, 1901, tow-net on dredge.—Thirteen, 3 to 7 mm., one 12 mm., ovigerous female.

50 mi. off Cleggan, 116 to 120 fath., July, 1903, tow-net on trawl.—Three, 8 mm.

Distribution.—British Islands to Mediterranean. The species extends, as shown above, to the 100 fathom-line, but, from the majority of records, is littoral rather than of the Atlantic Slope, though not found in very shallow water. It was taken by the *Porcupine* off Rockall.

It is chiefly known to us from hauls which seem to locate it in the neighbourhood of the bottom, but an International record proves its occurrence at the surface, off Weymouth, in February, 1904, over water of from about 28 to 53 fathoms.

SUB-FAM. *BOREOMYSINAE*, H. & T.

GENUS **Boreomysis**, G. O. Sars.

Boreomysis arctica (Kröyer).

Helga.

77 mi. off Achill, 382 fath., August, 1901, tow-net on trawl.—One, 10 mm.

48 mi. off Tearaght, 337 fath., November, 1904, tow-net on trawl.—One, 8 mm.

75 mi. off Fastnet, 181 fath., May, 1904, tow-net on trawl.—One, 15 mm.

Distribution.—Jan Mayen, Lofoten to Christiania Fjord, 200 to 400 fath.; North Sea, Greenland, and N.E. America. Presumably extending southwards, at suitable depths and on suitable ground, from its northern observed limit to Ireland.

We have alluded (p. 130) to the characters of two specimens which, though small, seem clearly referable to this species. See note, p. 148.

Boreomysis tridens, G. O. Sars.

Helga.

54 mi. off Tearaght, 454 fath., November, 1904, tow-net on trawl.—Nine, 15-25 mm.

77 mi. off Achill, 382 fath., August, 1901, tow-net on trawl.—One male, 26 mm., one ovigerous female, 28 mm.

Distribution.—Norway—Lofoten, Trondjhem and Vestfiords, 300 to 400 fath. Presumably extending between Norway and Ireland at suitable soundings.

Boreomysis megalops, G. O. Sars.

Helga.

60 mi. off Achill, 199 fath., August, 1901, tow-net on trawl, with sand.—Ten, 10 to 17 mm., and many fragments. Tow-net on dredge.—About one hundred and thirty, 9 to 15 mm.

Inner edge of Porcupine Bank, 175 fath., end of June, 1901, tow-net on dredge.—One, 5 mm., apparently referable to this species, but too young for certain determination.

50 mi. off Cleggan Head, 120 fath., July, 1903, tow-net on trawl.—Two, very small, one adult.

Distribution.—Norway, west coast and West Finmark, 80 to 200 fath., and presumably thence, at suitable soundings, to the Irish coast, where it is evidently common.

Boreomysis microps, G. O. Sars.

Helga.

50 mi. N. by W. (magn.) of Eagle Island, Co. Mayo, 1,000+fath., August, 1904, large tow-net 1,000 to 0 fath.—One, female, 21 mm.

The net in which our solitary example was captured was an open one, and therefore fishing both during the descent to and ascent from 1,000 fath., at which it worked. The specimen may, therefore, have been caught anywhere between the surface and 1,000 fathoms. All that is certain is, that it was obtained at least some considerable distance from the bottom (which on the chart was shown to be several hundred fathoms below the greatest depth reached by the net). The circumstances of its capture, therefore, point to its being, at least in part, pelagic, in which respect it would seem to differ from its congeners, which are apparently all bottom haunting forms. The method of capture of the Challenger example is not stated, but the depth at the station at which it was taken was 1,250 fathoms.

Distribution.—The Challenger obtained a single individual of this species south of Nova Scotia, in lat. 42° 8′ N., long. 63° 39′ W. It has not since been obtained. The present record, therefore, considerably extends the geographical range of the species.

SUB-FAM. *MYSIDELLINAE*, Czerniavsky.

GENUS **Mysidella,** G. O. Sars.

Mysidella typica, G. O. Sars.

Helga.

50 mi. off Cleggan Head, 116 to 120 fath., July, 1903, tow-net on trawl. —Two, adult.

Same place, depth and net, August, 1903.—Five, adult.

Distribution.—West Norway, 50 to 150 fath.; S. W. Ireland, 52 to 62 fath.*; W. of Ireland, as above, and presumably from Norway to Ireland at suitable soundings.

So small a species is very likely to escape notice, and we expect that if any means reasonably calculated to effect its capture are employed, it will be found to extend into the North Sea and English Channel, as well as southwards of its present known range. It does not seem to enter the Irish Sea.

* In 1890 and 1901.

Boreomysis arctica, see pp. 130 and 147.

In February, 1905, a number of adult specimens, undoubtedly belonging to this species, were taken off Tearaght, Co. Kerry.

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EXPLANATION OF PLATES XV. TO XXV.

Plate XV.

Thysanoessa longicaudata (Kröyer).

Fig. 1. Dorsal view.
Fig. 2. Lateral view.
Fig. 3. Lateral view of antennular peduncle, enlarged.
Fig. 4. Antennal scale, enlarged.
Fig. 5. Leg of the second pair, enlarged.

Plate XVI.

Meganyctiphanes norvegica (Sars).

Fig. 1. Female. Lateral view.
Fig. 2. Carapace, lateral view.
Fig. 3. Carapace, dorsal view.
Fig. 4. Carapace, dorsal view, slightly flattened.

Plate XVII.

Nyctiphanes Couchi (Bell).

Fig. 1. Male. Lateral view.
Fig. 2. Ovigerous female. Lateral view.
Fig. 3. Antennular comb of female, enlarged.

Plate XVIII.

Gnathophausia drepanephora, sp. n.

Fig. 1. Male. Lateral view.
Fig. 2. Base of antennular flagellum of male, enlarged.
Fig. 3. Antennal scale, enlarged.

Plate XIX.

Chunomysis diadema, g. et. sp. n.

Fig. 1. Female. Dorsal view.
Fig. 2. Antennal peduncle. Lateral view.
Fig. 3. Telson (of another specimen), enlarged.
Fig. 4. Telson (of Fig. 1), enlarged.

Meterythrops picta, sp. n.

Fig. 5. Immature male. Dorsal view.
Fig. 6. Telson, enlarged.
Fig. 7. Male process of antennule, enlarged.

Plate XX.

Katerythrops Oceanae, g. et sp. n.

Fig. 1. Immature male. Dorsal view.
Fig. 2. Immature male. Lateral view.
Fig. 3. Antennal scale with peduncle, enlarged.
Fig. 4. Endopodite of the leg of the 1st pair, enlarged.
Fig. 5. Pleopod of the 1st pair, ventral view, enlarged.
Fig. 6. Telson, enlarged.

Plate XXI.

Paramblyops rostrata, g. et sp. n.

Fig. 1. Male. Dorsal view.
Fig. 2. Female. Dorsal view of anterior end.
Fig. 3. Rostrum, enlarged.
Fig. 4. Eye, enlarged.
Fig. 5. Antennal scale, enlarged.
Fig. 6. Leg of 2nd pair, enlarged.
Fig. 7. Endopodite of one of the posterior thoracic legs (5th ?), enlarged.
Fig. 8. Telson, enlarged.

Plate XXII.

Dactylerythrops dactylops, g. et sp. n.

Fig. 1. Female. Dorsal view.
Fig. 2. Female. Dorsal view of anterior end.
Fig. 3. Lateral view of eye, enlarged.
Fig. 4. Dorsal view of eye, enlarged.
Fig. 5. Pleopod of the 1st pair, enlarged.
Fig. 6. Telson, enlarged.

Plate XXIII.

Hypererythrops serriventer, g. et sp. n.

Fig. 1. Male. Dorsal view.
Fig. 2. Male. Dorsal view of anterior end.
Fig. 3. Antennal peduncle and scale, enlarged.
Fig. 4. Mandible, enlarged.
Fig. 5. 1st Maxilla, enlarged.
Fig. 6. 2nd Maxilla, enlarged.
Fig. 7. Leg of the 1st pair, enlarged.
Fig. 8. Processes on the ventrum of the male, with the base of the last thoracic leg showing the epipodite, and the male copulatory organ.
Fig. 9. Telson, enlarged.

Plate XXIV.

Euchaetomera Fowleri, sp. n.

Fig. 1. Male. Dorsal view.
Fig. 2. Leg of the 2nd pair, enlarged.
Fig. 3. Extremity of the telson, enlarged.

Hypererythrops serriventer, g. et sp. n.

Fig. 4. Leg of the 2nd pair, enlarged.

Mysideis insignis, G. O. Sars.

Fig. 5. Telson, enlarged.

Euphausia Lanei, sp. n.

Fig. 6. Basal joint of antennular peduncle, enlarged.
Fig. 7. Leg of the 1st pair, enlarged.
Fig. 8. Leg of the 2nd pair, enlarged.
Fig. 9. Extremity of the terminal joint of the leg of the 2nd pair, still further enlarged.

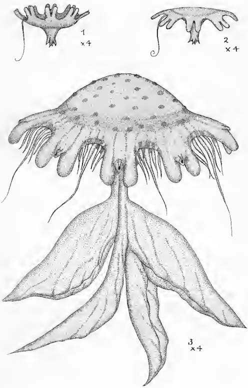
PLATE XXV.

Chunomysis diadema, g. et sp. n.

Fig. 1. Mandible, enlarged.
Fig. 2. Cutting edge of right mandible, further enlarged.
Fig. 3. Cutting edge of left mandible, enlarged.
Fig. 4. 1st maxilla, enlarged.
Fig. 5. 2nd maxilla, enlarged.
Fig. 6. Leg of the 1st pair enlarged.
Fig. 7. Leg of the 2nd pair, enlarged.

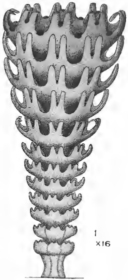
Meterythrops picta, sp. n.

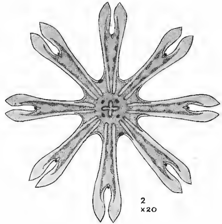
Fig. 8. Leg of the 1st pair, enlarged.
Fig. 9. Leg of the 2nd pair, enlarged.



CYANEA LAMARCKII.

M. J. Delap, del.





CYANEA LAMARCKII.

M, J Delap, del

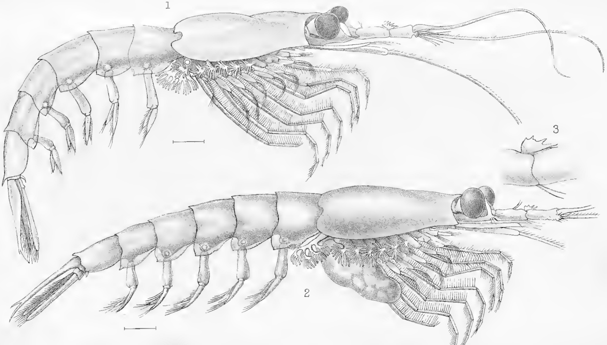
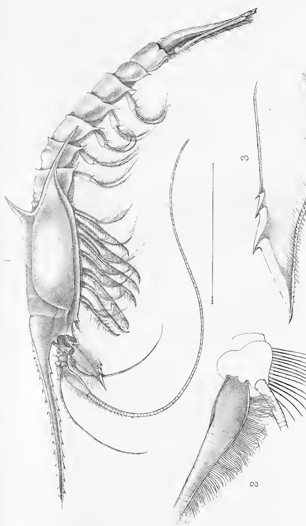


Fig. 1. C. Green del. caet.
G. M. Woodward del. et lith.

West, Newman imp.

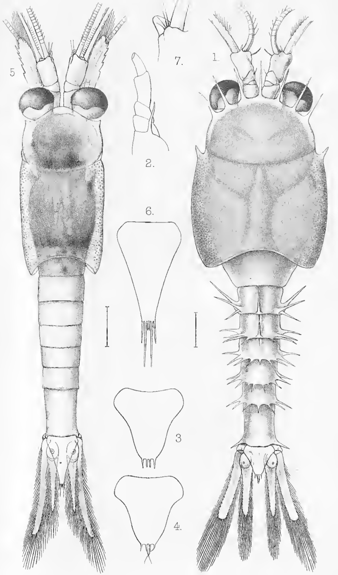
Nyctiphanes Couchi.



Gnathophausia drepanephora

Fig 1 C Green, cast E W L H del.
G M Woodward lith

West, Newman imp.

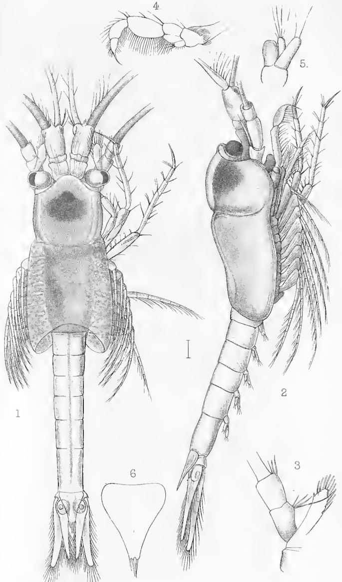


G M Woodward del. et lith.

West, Newman imp

Meterythrops picta.

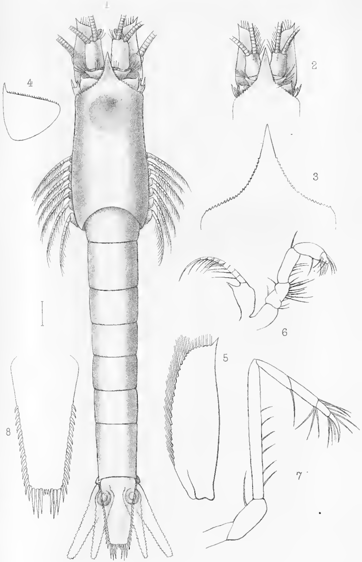
Chunomysis diadema



E.W.L. Holt del.
G.M. Woodward lith.

West, Newman imp.

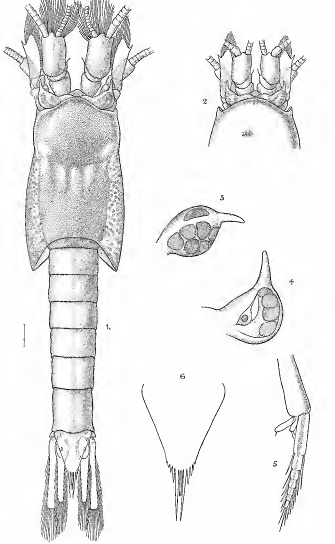
Katerythrops Oceanae



G M Woodward del et lith.

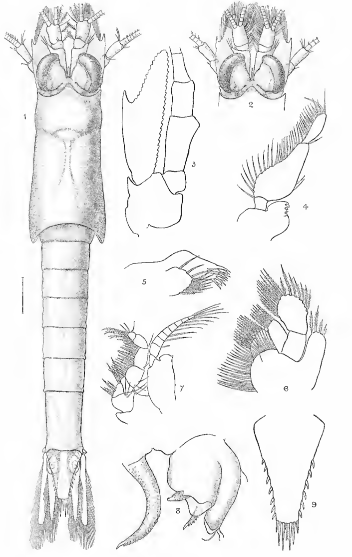
West, Newman imp.

Paramblyops rostrata

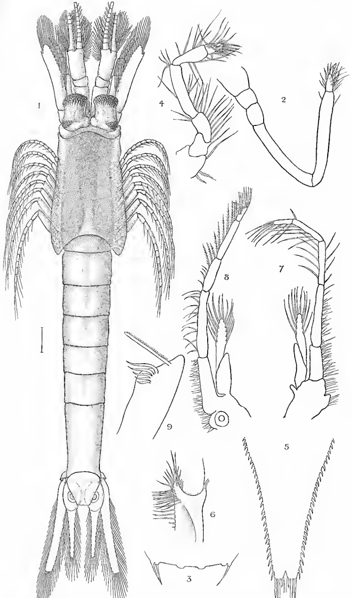


Dactylerythrops dactylops.

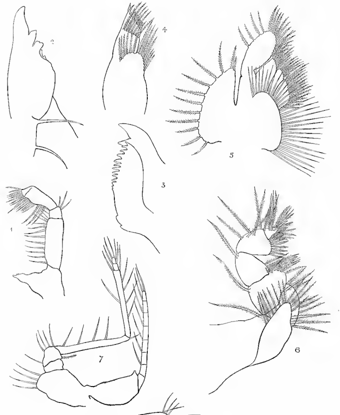
Pl. XXIII.



Hypererythrops serriventer.



1-3. Euchaetomera Fowleri. 4. Hypererythrops serriventer.
5. Mysideis insignis. 6-9. Euphausia Lanei.



W. M. Tattersall del.

1-7. Chunomysis diadema.
8-9. Meterythrops picta.

ii.—NOTE ON A GENUS OF EUPHAUSID CRUSTACEA.

BY

W. T. Calman, D.Sc.

Plate XXVI.

The genus *Nematodactylus* was established by the present writer in 1896 for a new species of Euphausid crustacean, of which a single imperfect specimen had been obtained by the Royal Irish Academy Expedition of 1888 from deep water off the South-West of Ireland.

Five specimens of the same species have now been detected among the Euphausiidae collected by Dr. G. H. Fowler on the "Research" Expedition off the Bay of Biscay, and entrusted to Mr. E. W. L. Holt for examination. I am indebted to Dr. Fowler and Mr. Holt for the opportunity of examining these specimens and thereby extending and correcting the account which I formerly gave of the species. It is necessary, unfortunately, to give a new name to the genus since, as Dr. Theodore Gill has pointed out to me, *Nematodactylus* is preoccupied for a genus of fishes.

Genus **Nematobrachion**, nom. nov.

Nematodactylus, Calman, Trans. Roy. Irish Acad. xxxi., p. 16, 1896; non *Nemadactylus*, Richardson, Proc. Zool. Soc., London, 1839, p. 98; corrected to *Nematodactylus*, Gill, Proc. Acad. Nat. Sci., Philadelphia, 1862, p. 121.

Nematobrachion boöpis.

Nematodactylus boöpis, Calman, Trans. Roy. Irish Acad. xxxi., p. 17, pl. ii., fig. 19-28, 1896.

The carapace is marked by a shallow cervical groove, in front of which is a median dorsal keel running forwards to the short rostrum and slightly elevated about the middle of its length. The pleural plates ("epimera") of the third, fourth, and fifth abdominal somites have the lower margin slightly sinuate.

The eye is not quite correctly described as globose. On the outer surface is a short groove which, according to the position of the eye, may be horizontal or nearly vertical, and which divides the corneal area into a large fronto-dorsal and a much smaller lateral part. As this groove is confined to the lateral surface and does not encircle the eye, it does not give, when viewed from the side, the appearance of constriction which is so characteristic of the eyes in related forms. In the other species which I have referred to this genus, *N. flexipes* (Ortmann), the eye is divided by a marked constriction, and the two parts are nearly equal in size. In the present species there is a luminous organ (not mentioned in the original description) on the ocular peduncle, immediately behind the lateral division of the eye, and just above it the integument of the peduncle forms a slight ridge outside and parallel to the margin of the corneal area.

In the specimen formerly described the flagella of antennules and antennae were wanting. In a female, 20 mm. in length, in the present collection the flagella of the antennule, though not quite complete, measure 13 mm. from the distal end of the peduncle and the flagellum of the antenna 19 mm.

The antennal scale (fig. 2) is incorrectly represented in the figure formerly given (*l.c.* pl. II., fig. 20). It reaches to the middle of the third segment of the antennular peduncle, and is five times as long as broad. The outer margin is nearly straight, its distal tooth very minute, and the apex of the scale is rounded.

As regards the mouth-parts, dissection of one of the specimens enables me to confirm, on all essential points, the account already given. The form of the maxillula ("first maxilla") is very characteristic, the outer plate (the so-called "exognath") being absent, as in *Stylocheiron*, and the palp unusually narrow.

The third thoracic limb (second leg of Sars' terminology and of the original description) has the ischium slightly longer than the merus. There are five (not six) "harpoon-like" spines on the dactylus, four of them terminal and one inserted on the inner side a little way from the distal end.

The penultimate thoracic limb, as already pointed out, presents the full number of segments, as in *Bentheuphausia* and *Thysanopoda*.

The last thoracic limb (fig. 3) differs in shape from those of the allied genera, and resembles more closely that of *Thysanopoda* as figured by Sars (Challenger Rep. Schizopoda, pl. xvii., fig. 17a). The movable leaflet has the form of an exopod divided into a proximal and a distal portion, the latter fringed with setae. The basal lobe with which the exopod articulates bears six long and stout plumose setae on its inner edge.

There is no epipod on the first thoracic limb. The gills of the second and third have only a single branch, the five remaining gills have a ventral, or inner branch, as in *Nematoscelis*. In the first six gills the axis of the outer or dorsal branch is not so distinctly bifurcate as in that genus.

Two of the specimens obtained are adult females, each carrying a single ovoid spermatophore attached by a long slender neck to the region of the genital apertures. The single male specimen is much mutilated, but appears not to differ in general characters from the female. The outer flagellum of the antennule is dilated close to the base. The sexual appendages of the first and second pleopods are figured (fig. 4 and 5) for comparison with those of related forms. That of the first pair is much more complex than the corresponding appendages of *Stylocheiron* (Sars, Rep. Challenger Schizopola, pl. xxvi., fig. 25 and 26) or *Nematoscelis* (Chun, Bibl. Zool. vii., Heft 19, pl. xii., fig. 7 and 8).

The following is a list of the specimens :—

No. 32p,	1 adult ♀, 20 mm. in length.
No. 35p,	1 immature.
No. 36g,	1 do.
No. 36h,	1 adult ♂.
No. 36i,	1 adult ♀.

It may be useful to recapitulate in the form of a key the leading characters of those genera of *Euphausiidae* which are distinguished by the elongation of one of the pairs of thoracic appendages.

A. *Second* pair of thoracic limbs elongated. Maxillula with outer plate ("exognath").

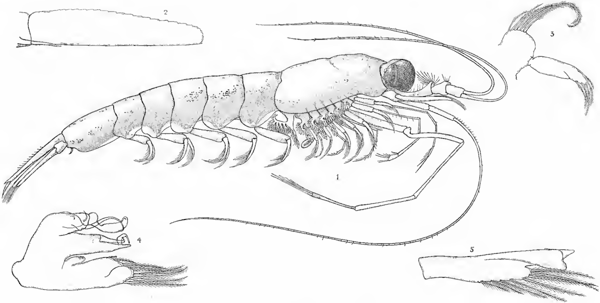
(*a.*) Second thoracic limbs moderately elongated, the distal segments with marginal setae. Last three pairs of gills two-branched.

Thysanoëssa, Brandt.

(*b.*) Second thoracic limbs greatly elongated and slender, with a terminal group of spines. Last five pairs of gills two-branched.

Nematoscelis, G. O. Sars,

Pl. XXVI.



W. T. C. & G. M. W. del.

Nematobrachion boöpis.

B. *Third* pair of thoracic limbs elongated. Maxillula without outer plate.

(*a*.) Third thoracic limbs with terminal group of spines resembling those of second thoracic limbs of *Nematoscelis*. Penultimate thoracic limbs with endopod of five segments. Mandibles with palp. Luminous organs, one pair on eyestalks, two pairs thoracic and four unpaired abdominal. Gills well developed, last five pairs two-branched.

Nematobrachion, Calman.

(*b*.) Third thoracic limbs with more or less perfect chela. Penultimate thoracic limbs with endopod of two segments. Mandibles without palp. Luminous organs, one pair thoracic and one unpaired abdominal. Gills much reduced, only the last pair two-branched.

Stylocheiron, G. O. Sars.

A problem of some interest is suggested by the close resemblance which exists between the raptorial *third* thoracic limb of *Nematobrachion* and the similarly modified *second* thoracic limb of the closely allied *Nematoscelis*. In both the limb is tipped with a group of long slender harpoon-like spines which are serrated by a series of annular ridges not completely encircling the spine, but leaving a smooth space along one side. It is possible that this peculiar armature may have arisen independently in the two genera, and, indeed, this is assumed if the key given above be taken as representing the natural affinities of the various forms, but the case is very suggestive of that form of variation to which Mr. Bateson* has given the name of "homœosis," or rather, perhaps, of what Prof. E. Ray Lankester† has termed "translation of heterosis." The correlative change in the other appendages, however, does not quite meet the requirements of Prof. Lankester's definition, since the *first* thoracic limb of *Nematoscelis* is not exactly similar to the *second* of *Nematobrachion*. On either hypothesis it would be a difficult matter to construct a reasonably probable phylogenetic "tree" to express the relationships of the four genera above referred to.

EXPLANATION OF PLATE XXVI.

Fig. 1. *Nematobrachion boöpis*, adult female.
Fig. 2. " " antennal scale of adule male.
Fig. 3. " " last thoracic limb of adult female
Fig. 4. " " endopod of first pleopod of adult male.
Fig. 5. " " endopod of second pleopod of adult male.

* Materials for the Study of Variation, p. 85.
† Encycl. Brit, XXV., p. 692 (1902), and Quar. Jour. Micr. Sci. XLVII., p. 535 (1904).

Appendix, No. V.

i.—Note on a specimen of *Dentex vulgaris* from Dingle Bay, by E. W. L. Holt and L. W. Byrne.

ii.—The British and Irish Gobies, Supplement, by E. W. L. Holt and L. W. Byrne.

iii.—Figures and Descriptions of the British and Irish species of *Solea*, by E. W. L. Holt and L. W. Byrne.

i.—NOTE ON A SPECIMEN OF DENTEX VULGARIS FROM DINGLE BAY.

BY

E. W. L. Holt and L. W. Byrne.

Plate XXVII.

The specimen was taken by a sailing trawler in Dingle Bay on the 6th or 7th April, 1903, and came into our hands for determination through the courtesy of Dr. R. F. Scharff.

We ascertained by local inquiry that another fish, supposed to have been of the same kind, was taken shortly before on the same ground; but the description given was not sufficient to establish its identity.

Although not uncommon in the Mediterranean and neighbouring parts of the Atlantic, this is, so far as we are aware, the first record of the species from Irish waters.

There are four previous records of its appearance on the coasts of the British Isles:—

(1.) Off Troup Head, Banffshire (Edward, *ex relat. auct.*)*

(2.) Off Hastings, April, 1805, a specimen weighing 16 lbs. (Donovan, British Fishes, iv. p. 1, 1806.)

(3.) Falmouth Market, November, 1846, a specimen $32\frac{1}{2}$ in. long (Couch, I., p. 204, 1862.)

(4.) Falmouth Market, August, 1851, a specimen 56 in. long (Couch, *loc. cit.*).†

This species may be distinguished from all allied forms known to the fauna of the British Isles by the following short description:—

DENTEX VULGARIS, Cuv.

D. XI 10-12; A. III 8; Sc., $55\text{-}60\frac{6}{15}$.

Body moderately stout, sub-fusiform: depth of body $2\frac{4}{5}$ to $3\frac{1}{5}$ times in total length: depth of caudal peduncle about three times in depth of body: greatest thickness of body about twice in its depth. Head large and stout, 3 to $3\frac{1}{2}$ times in total length: eye 5 to 6 times in head and nearly twice in interorbital width. Snout $2\frac{1}{2}$ to $2\frac{3}{4}$ times in head. Preorbital large, almost entirely concealing the maxilla when the mouth is closed. Two large canine-like teeth on each side of each jaw, followed by a series of smaller sharply-pointed teeth varying somewhat in size. Dorsal and anal fins with a scaly basal sheath, into which they can be depressed; pectoral falciform, about $\frac{7}{8}$ of the distance from snout to its origin in length; caudal forked.

Sexual differences not certainly known. Some large specimens, apparently only males, with a large occipital hump.

* We have not been able to find Edward's original record.

† Mr. J. T. Cunningham, in the "Field" of 27th Aug., 1904, mentions a specimen of 35 in., said to have been taken near Weymouth. The place of capture of two other specimens, landed at Bournemouth, has been traced by Mr. Tate Regan to the coast of Portugal.

Colour probably not unlike that of the common bream in life, with a faint axillary spot and small black markings, which are more numerous in young specimens, on the upper part of the head and back.

Attains a length of nearly 1 m. (about 3 ft. 4 in.).

A more detailed description of the Dingle specimen, made after preservation for some time in formol, follows :—

Male with enlarged testes.

Body stout, subfusiform, and somewhat compressed in the abdominal region; caudal pêduncle subcylindrical. Length to end of caudal rays, 89 cm.; to fork of tail, 83 cm.; to origin of caudal fin, 75 cm. Depth of body about $2\frac{4}{5}$ times in length and somewhat greater than length of head. Greatest breadth of body half its depth. Depth of body at origin of dorsal fin, 26·8 cm.; at anterior end of caudal peduncle, 10·1 cm.; at lowest point of peduncle, 6·8 cm.; greatest breadth of body, 13·5 cm.

Head large and stout, nearly one-third of length of body, with a large occipital hump, which reaches further forward than the level of the front of the eye, and tumid orbital ridges above the nostrils, which unite on and form an angle with the front profile of the head. Eye about six times in head, nearly twice in the interorbital width, and $2\frac{1}{4}$ times in snout. Length of head 23.7 cm., eye 4 cm., interorbital width 7.7 cm. Distance from vertical of front of head to anterior end of hump, 7.5 cm.; to angle of supraorbital ridges, 5 cm.; to angle of jaw, about 8 cm.; vertical diameter of eye, 3.2 cm. Greatest height of head (.5 cm. in front of hind edge of preoperculum, 26 cm. Preorbital bone large, 8·5 cm. in extreme length (measured through skin), and 7 cm. from eye to its lowest point. Two large canine-like teeth on each side of each jaw, followed by a series of smaller sharp pointed teeth, varying somewhat in size. The exposed parts of the teeth of the left sido measure :—

Lower jaw—C1 12.5 mm.; C2 12.5 mm.; others 6 mm. *ca.*
Lower jaw—C1 12.5 mm.; C2 12.5 mm.; others 6 mm. *ca.*

Dorsal, pectoral, and ventral fins originating in the same vertical, about half way to origin of anal; distance to origin of caudal peduncle about $\frac{4}{5}$ of length, pectoral fin subfalciform, about $\frac{7}{8}$ of distance to its origin in length. D. XI. 11, A. III. 8, each with a scaly sheath, into which it can be depressed. Distance to origin of dorsal, pectoral, and ventral fins 25 cm., to end of pectoral 42.8 cm., to anus 45.5 cm., to origin of anal fin 49 cm., to origin of caudal peduncle 60.5 cm. Caudal fin deeply emarginate. Scales $60\frac{6}{15}$. Lateral line 59. Four rows of scales between eye and preoperculum.

Weight 28 lbs. (before preservation).

When first obtained the colours were very much like those of the common bream (*Pagellus centrodontus*), but there were some irregular black marks on the back. A faint dark patch occupied the position of the axillary spot.

While in other respects agreeing sufficiently with the specific diagnoses and figures givèn by authors, the cephalic contour of the example before us is remarkable in the presence of a large hump in the occipital region; which, in combination with the swollen ridges above the eyes, imparts a most singular effect to the profile and "full-face" aspect.

The contour, as it appeared after the specimen had been preserved for about a fortnight in dilute formaline, is faithfully reproduced in Miss Woodward's drawing (Pl. XXVII.), but it is the impression of one of us, who examined the fish before preservation, that the occipital hump was then somewhat larger.

The occurrence of an occipital prominence as a normal phase of development was unfamiliar to us, and we are indebted to Mr. Boulenger for a reference to Pellegrin's work on the subject. (Bull. Soc. Philomath. Paris, Ser. 9, III., p. 81, 1901). The author shows that the prominence, due to the development of tissue of an adipose nature, occurs with such regularity in certain species of the Perciform families *Labridae*, *Cichlidae*, and *Sparidae*, that, if not an invariable feature in the development of these species, it is at any rate not susceptible of a pathological explanation. His observations, and those of other writers (*cf.* Günther, Cat., IV., p. 288, *Heros*; Jordan and Evermann, Fishes N. and M. America, p. 1,519, *Cichlasoma*, *Heros*, p. 1,581, *Harpe*, p. 1,585, *Pime-*

lometopon), point to the occipital hump being a character of the adult, and to its almost invariable absence from the young.

Pellegrin clearly inclines to regard it as a male sexual character, but, as he is careful to state, this is a matter of inference rather than proof in so far as concerns the *Cichlidae*. Among the *Labridae*, however, there seems to be no doubt that in some cases the presence of an occipital hump is a character of the male sex; (*cf.* Jordan and Evermann's descriptions of *Harpe* [= *Cossyphus* of Günther and Pellegrin] and *Pimelometopon* above mentioned, quoted by Pellegrin, and the figure given by the latter author). It is also perhaps worth noting in this connection that in *Coryphaena hippurus* and *Coryphaena equisetis* the supraoccipital crest is more developed in the male than in the female, although a marked fatty hump does not seem to occur in either sex (Lutken, Spolia Atlantica, Vid. Selsk, Skr. Kjbhvn, Ser. 5, XII., 593, 1880), and, as Pellegrin points out, the supraoccipital crest is largely developed in the species which possess a fatty hump, although the extreme development of the latter is not in any sense a necessary or natural result of the presence of the former.

Among the *Sparidae* this hump is found in some species of *Chrysophrys Sargus*, and *Dentex*.

Gilchrist* says of *Chrysophrys globiceps*:—"As a rule the profile of the head region arises much more abruptly from the end of the snout in the male than in the female," and of *C. gibbiceps*:—"The male can, as a rule, be distinguished from the female by the greater prominence of the frontal region. Exceptional cases are, however, met with where this feature is absent in the male, and others in which it is highly developed, the head projecting considerably beyond the vertical from the end of the snout." Among other species in which this hump occurs, Pellegrin cites *Dentex vulgaris*, and indeed remarks that the skin of a specimen of 83 cm. from the Canaries presents a greater development of the occipital hump than any other fish examined by him. His figure (*op. cit.*, p. 89, Fig. 5) shows an immense cap-like prominence extending from the level of the anterior nostril to a little in front of the first dorsal spine, its anterior and posterior margins rising abruptly from the general profile, possibly somewhat distorted by the removal of the underlying bones and muscles. A manuscript label in Valenciennes' writing remarks of the specimen that similar examples are said to occur from time to time at the Canaries, and attributes the prominence to a hypertrophy of the supraoccipital ridge. From this view Pellegrin dissents, remarking that although, as he has shown in *Geophagus*, the supraoccipital crest plays a certain part in the form of the profile, so voluminous a prominence must be largely composed, as in other species examined, of adipose tissue.

The Dingle *Dentex* is a male with largely developed testes, ripe or nearly so. So far as we can ascertain by sounding with a needle the occipital hump is not accompanied by any exceptional development of the supra-occipital crest.

For comparison we have figured a smaller example from the British Museum, which appears to be also a male, and is quite destitute of hump. Donovan's figure, taken from a large specimen (16 lbs.), seems to be correctly drawn. It shows no hump and there is no record of sex. Day took his figure from a very young example, too small to possess this character, if Pellegrin's interpretation of the matter is correct. Couch copied Donovan's figure, and does not appear to have seen the large examples which he records on the authority of other observers. As no mention is made of it, it may be presumed that neither possessed the hump, which is a character sufficiently striking to attract immediate attention.†

Pellegrin, in concluding his most interesting memoir, remarks that many instances could no doubt be added:—"Car il s'agit d'un phénomène non pathologique mais en quelque sorte periodique rappelant par example ce qui passe chez les Salmonides pour les individus dits bécards. D'ailleurs il n'est pas étonnant que parmi les Poissons on rencontre parfois chez les mâles, surtout chez les sujets parvenus à un âge avancé, des caractères morphologiques particuliers qui ne peuvent pas être précisément considérés comme anormaux."

* Marine Investigations in South Africa, II. 183, 1903.

† The Weymouth specimen, we are informed by Mr. Tate Regan, was a male, 87 cm. in total length, 75 cm. without caudal fin. It had no supraorbital-hump.

By whatever process it is accomplished the beak of a male salmon, developed shortly before the breeding season, is in great part reduced thereafter, to reappear again before the next period of reproductive activity. It is not suggested by Pellegrin that the occipital hump of Dentex, etc., has a similar relationship to the season of reproduction. Indeed, if, as the author conjectures (*op. cit.*, p. 84), the hump is to be interpreted as reserve of fat which can be drawn upon in case of famine, probability would seem to point to its reduction during the drain on the system involved by the maturation of the sexual products. If, however, it prove to be really a phenomenon confined to large males (and, as we may suppose, appearing, and then in a lesser degree, only in very large females), its material would not seem of importance for conversion into generative matter, since it would be required by the female at least as much as by the male, except in the species in which the male requires, in connection with reproduction, a greater store of nutritive matter than the female. Such cases may possibly be presented by forms in which the normal male roe is larger than or at least requires a greater consumption of food material than the normal female roe. More familiar instances are found among species in which the male undertakes the duties of nidification and care of ova—duties which must practically preclude him from feeding during the period which they occupy. Circumstances of this latter nature might well be supposed to influence the development of the hump in many *Cichlidae*, in which the parent carries the ova during development in the gullet or pharynx (*cf.* Boulenger, Poissons du Bassin du Congo, 1901, p. 394, and "Field" 1902, p. 33, and 1904, p. 951); but it appears that the sex of the parent so occupied varies in different species. It is certainly noteworthy that Louis Agassiz particularly remarks that in *Geophagus* the occipital hump is only present in the adult male, and that in that species the ova are carried during development in the pharynx of the male. In the African and Syrian species of this family, however, the occurrence of an occipital hump does not seem to have been recorded in the female of any species, although, so far as is known, that sex is always the nurse in these forms. In *Dentex vulgaris* the ova appear to be pelagic (Holt, Ann. Mus. Marseille, V., 4, 1899), and if so require no care from either parent, and the ova of *Chrysophrys globiceps* and *C. gibbiceps* are known to be pelagic (Gilchrist, *loc. cit.*).

Again, the familiar wrasses or conners of the British Isles are all alike in the absence, in either sex, of any noticeable adipose reserve in the head or elsewhere, although among those of the genus *Labrus* the male makes a nest and guards the ova deposited therein, while in *Ctenolabrus* and *Centrolabrus* the ova are pelagic. Fat, of course, is accumulated on the mesenteries, but we have no observations to show that it preponderates in either sex. In other of our well-known fishes in which the male guards the brood, such as *Gobius*, *Cyclopterus*, and *Lepadogaster*, no reserve of fat comparable to that of the species dealt with by Dr. Pellegrin is found; nor is there any such provision in *Callionymus*, a genus in which, though the ova are pelagic, the male undertakes arduous labours in connection with pairing. Among the pipe-fishes the male carries the ova, but has no obvious adipose reserve.

In the present state of our knowledge it seems therefore impossible to trace any constant correlation between a nesting, nursing or pairing habit, and the occurrence in either parent of an occipital hump or other noteworthy reserve of adipose matter.

Pellegrin's suggested comparison between the occipital hump of *Dentex*, &c., and the beak of a salmon is not, of course, intended by that author to be too narrowly criticised. The salmon's beak is merely cited as an instance of a physiological character confined to the male sex. It is a feature which varies greatly in individuals, and, as we have some reason to believe, in localities; but only reaches its maximum development in very large (and, presumably, old) examples.

Though a fully developed beak, forcing its way, as it not infrequently does, through the tissues of the snout, can hardly be of much value to its possessor, such an organ is clearly derived from the excessive development of a condition of the lower jaw, which condition, in a normal state of development, is most useful in combats on the redds. In trout, and even in young salmon, the elongation and curvature of the lower jaw of the

breeding male is no doubt of direct service: American charr (*S. fontinalis*), we believe, use it with great effect in getting a grip of the isthmus of a rival. The beak must, therefore, be regarded as something more than a mere manifestation of physiological activity. We know of no observations which would assist in correlating the degree of beak attained during the breeding season with the degree of nutrition of fish on entering fresh water or with the length of the period which may have elapsed between entering fresh water (and ceasing to add to nutrition) and breeding; nor, supposing the reduction of the beak to be accomplished by re-absorption, is there anything to show what time is occupied by this process, or to what extent it is contemporaneous with feeding. Indeed, since slats (kelts) with ultra-developed beak are rather commonly found dead, it is not clear to us that such examples have any subsequent life-history; and, on the whole, it seems most unlikely that the feature can be truly regarded as a reserve on which the possessor may draw during the period of recuperation. In any case, since in the Atlantic species the female alone labours at the making of the redd, the beak (if in any sense a reserve) is not associated with the sex upon which the strain of reproduction must tell most heavily.

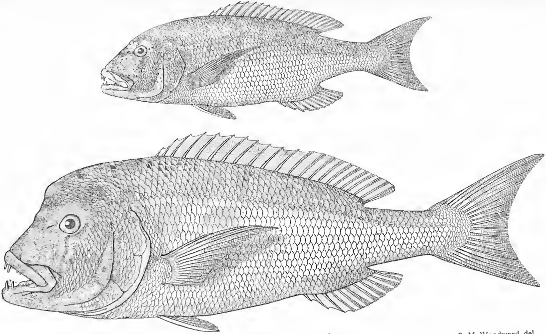
In all the Pacific salmon of the genus *Oncorhynchus* there is found a phenomenon which at first sight appears much more akin to the occipital hump of *Dentex*, &c., than is the beak, which, be it remarked, is present in *Oncorhynchus* as well as in *Salmo*. We refer to the dorsal hump of the male, which reaches its greatest development in *O. gorbuscha*. According to Jordan and Evermann,* the Pacific salmon differ in two important respects from their Atlantic kindred—(i) the male constructs the redd, and (ii) most (or probably all) males die after once spawning.

The first statement is so often made on respectable, if unreliable, authority in regard to Atlantic salmon that we are tempted to question its accuracy even in regard to forms of which we have no personal knowledge; but the real difficulty in regarding the humped back of a Pacific salmon as a store of fatty tissue (we are acquainted with no observations of its actual nature) laid up to meet the exigencies of the breeding season, appears to be its absence in early running fish and its constant presence in slats, which is the contrary of what one would expect to find were it a character of that nature. It is not impossible that it may result from the reduction of fatty tissue in the neighbouring parts, and thus be merely a phase of emaciation, which the comparatively weak and soft bones of *Onchorhynchus* make possible, but which is prevented in *Salmo* by the firmer and harder character of the skeleton.

In conclusion we are fain to confess that we have been able to find no means of properly estimating the significance and utility of the occipital hump. We have dealt with it at such length because we cannot but regard it as a phenomenon which would admit of easy interpretation were our knowledge of the bionomics and physiology of fishes somewhat more free of the Cimmerian darkness that still enshrouds all but the taxonomy of that class of the animal kingdom. In some cases the hump appears to be a character of the old male and constant in its occurrence. In others, including *Dentex*, it is not constant in the large males. In others there is as yet no clear evidence of its sexual nature; and, in the absence of information as to season of capture in relation to season of reproduction or conditions of nutrition, it can only be stated to manifest itself occasionally in large individuals.

Pellegrin inclines to regard the occipital hump as a secondary sexual character, confined to old males, and when we turn to secondary characters of a more tangible nature, such as elongated fin rays, we find that within the limits of a single genus such features may have a sexual nature or not. Thus in *Gobius*, and its allies, the male commonly has larger dorsal fins than the female. In *Gobius niger* the male has certain of the rays of the spinous dorsal produced into filaments; in *Gobius Friesi* this prolongation appears to be equally present in the female. In *Arnoglossus laterna* large (and, presumably, old) males have the anterior dorsal rays much prolonged, and, while old females show a slight tendency to the same condition: small males, even though sexually mature, and females show none of it. In *Arnoglossus Grohmanni* the second ray

* American food and game Fishes, 1902, p. 145.



G. M Woodward del.

Dentex vulgaris $\times \frac{1}{5}$.

of the dorsal is prolonged in all sexes throughout life; and, although it has been stated that this ray is more profusely adorned with membranous fringe in the adult male than in the female,* our own experience of considerable material proves clearly that this is a matter of individual and not of sexual variation. *Coris julis* and *Callionymus lyra* both exhibit a prolongation of dorsal rays (anal also in *Callionymus*) in large, but no noticeable prolongation in small, sexually mature males. *Callionymus maculatus* resembles the commoner British species in the sexual differences of its fins, but in some of the exotic forms these structures appear to be equally developed in both sexes, or even to attain a greater development in the female than in the male (Alcock, Catalogue of Indain Deep-Sea Fishes, 73-74, 1899.)

In some of the forms we have mentioned as exhibiting secondary sexual characters of fins, and in others in which obvious differences of this nature are confined to colouration, we know that the male quarrels with his fellows about his partner and guards the ova, when demersal; and in cases where no such conduct is known to occur, it will be found that we have no information at all of the breeding habit. There would, therefore, seem to be a *prima facie* case for regarding these characters as possibly of some importance in connection with the sexual functions, though with the nature of their import we are not here concerned.†

In the case of the occipital hump there is, as we have seen, no evidence of any such relation; but although not strictly comparable to elongation of fins or brilliance of colouration, it is not unreasonable to assume that, like them, an accumulation of fatty tissue may be a result of a physiological activity which is, in the breeding season, more marked in the male than in the female, whose whole resources are required for the proper development of the ova, and—provided this accumulation is not required to meet the demands of some special breeding habit of the male—there seems no reason why the presence of an occipital hump should not become a more or less permanent character of that sex. Unlike elongated fin rays or brilliant colours, a fatty growth of this nature would not become an exhausting outgrowth to be suppressed as soon as the reproductive activity was past,‡ but would remain an useful asset in the event of the available food supply at any future period proving insufficient for the nutrition of its owner.

* Cunningham, P.Z.S., 1890, p. 540.

† It would not be difficult to make a long list of forms exhibiting sexual differences, such as ciliation of scales in the male (*e.g. Pleuronectes platessa*), or heavier dermal armature in the female (as in most of the *Raiidae*). The difference in shape of dorsum, flat in the male, convex in the female, in *Nerophis aequoreus* is perhaps worthy of passing mention as exceptional in a group in which the male parent always carries the ova during development.

‡ It is to us a matter of uncertainty whether the filamentous extension of the fin rays in such a form as *Gobius niger* are or are not reduced after the breeding season, but there is evidence that in *Gobius minutus* the elongated rays of the soft dorsal and anal of the male are lost almost immediately on the conclusion of the breeding season (see Report for 1901, Part II., pp. 62, 63 [1903]). In *Callionymus* observation throughout the year seems to show that no sensible reduction takes place. There is, however, in all cases with which we are acquainted, a most obvious diminution in the brilliance of the colouration after the breeding season, but since, in some forms at any rate, the substances which give rise to the breeding colouration may be due to an excessive activity of the excretory system in sympathy with the stimulation of the generative organs, the development of fin rays and the production of colouration elements ought perhaps to be regarded as due to physiological causes of an entirely different nature.

EXPLANATION OF PLATE XXVII.

DENTEX VULGARIS, Cuv.

Large male, with occipital hump, from Dingle Bay.

Smaller example, sex not ascertained, from the British Museum.

Both figures are drawn to the same scale, viz. $\times \frac{1}{5}$.

ii.—THE BRITISH AND IRISH GOBIES.

SUPPLEMENT.

BY

E. W. L. Holt and L. W. Byrne.

Plate XXVIII.

In our account of the British and Irish Gobies (Report for 1901, Pt. II., Appendix No. III.) we referred to the possible occurrence of *Gobius capito* on our coasts, and gave a brief diagnosis.

Since then Mr. F. Pickard-Cambridge (Ann. Mag. Nat. Hist., S. 7, XII., p. 584, 1903) has confirmed Boulenger's suggestion of the identity of the large Goby described by Couch with this species.

It is in order to make our own account of the genus complete, and not to supplement Cambridge's excellent paper, that we offer the following notes, in which, as will be seen, we have availed ourselves largely of Cambridge's observations. We are indebted to Mr. Boulenger for the opportunity to figure a British specimen.

The key to the British and Irish gobies given in last year's Report must be amended, as follows, to include *G. capito*:—

A.—Ventrals with anterior membrane.

1. Superior rays of pectoral separate and silk-like.
   - (*a.*) Anterior membrane of ventrals separated from fin rays and forming lateral lobes; interorbital space two-thirds or more in diameter of eye; 60 or more scales in a longitudinal series; spinous dorsal without elongated rays or superior pale horizontal band.

     G. capito.

   - (*b.*) Anterior membrane of ventrals continuous with fin-rays; interorbital space narrow and eyes almost touching superiorly.
     - i. Not more than 42 scales in a longitudinal series; middle rays of spinous dorsal longest.

       G. niger.

     - ii. 50 or more scales in a longitudinal series; spinous dorsal with a superior pale horizontal band.

       G. paganellus.

GOBIUS CAPITO, C. and V.

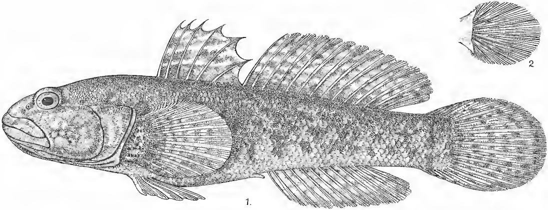
Giant Goby.

Plate XXVIII.

Habit, stout and heavy; form, subcylindrical; depth of body (at anus), 5 to 6 times in total length; length of head, $3\frac{1}{2}$ to $4\frac{1}{4}$; head very broad and heavy; snout, 3 to $4\frac{1}{2}$ in length of head; eye, 5 to $6\frac{1}{2}$; interorbital space, $\frac{2}{3}$ (in young) to slightly less than diameter of eye; scales, 60-68* in

☞ * We gave 60–62, counted in Mediterranean examples, in the last Report. Boulenger found 61 in specimens from Brittany, Pickard Cambridge 65–68 in his Cornish specimens. The variation may be local, but is more likely due to the difficulty, alluded to by us in the last report, in counting scales in Gobies on uniform principles,

Pl. XXVIII.



G. M. Woodward del.

Fig. 1. Gobius capito. × 1.
Fig. 2. Ventral fins, from below, × 1.

a longitudinal, 18-22 in a transverse series; 15 across anterior end of caudal peduncle; decreasing in size anteriorly and minute and almost buried in the skin on the head and forepart of the back. Pectorals with branched extremities of 2 or 3 upper rays produced into short silk-like filaments; anterior membrane of ventrals separated by a notch from fin-rays and forming a lobe on either side, which is, *teste* Pickard-Cambridge, rounded in the adult and pointed in the young. Spinous dorsal with VI., soft dorsal with 14-15 rays, anal with 11-13 rays. Caudal obtusely rounded.

Colour—*teste* Pickard-Cambridge—"Very variable in different individuals, ranging from pale orange-pink or sandy to sooty-black. Freshly caught examples are beautifully mottled with various markings of different shades of grey." Unpaired fins with irregular rows of sooty-black blotches, no pale band at the margin of the dorsal. Small Mediterranean specimens are generally darker than the adults, which, at Marseilles, are usually dull brown with more or less mottling of dark brown and dull yellow.

Attains a length of 10 inches or more.

No change of colouration has been observed in the breeding male

Apparently allied to *G. paganellus*, but a much larger species. Distinguishable from all other British and Irish gobies by the wide interorbital space, the form of the ventral and form and colour of the spinous dorsal fins, and the number of scales.

The Giant Goby is common in the Mediterranean, and its range extends to the western end of the English Channel. In Brittany and Cornwall it is found chiefly in oyster ponds and rock pools, often in places reached only by spring tides.* In England, apparently very local in distribution; we have failed to find it, in spite of careful search, on the coast of Devon or the north coast of Cornwall, and in Falmouth Harbour. Couch found it, probably near Polperro, and Pickard-Cambridge at Port Scatho, between Falmouth and Fowey, where it is, seemingly, locally abundant. So far there is no record of its occurrence in Ireland, but the above notes indicate the situations in which it may be sought with most chance of success.

The ova resemble those of *G. paganellus*, but are much larger, measuring about 3·6 mm. by 1·23 mm. In the aquarium at Endoûme, Marseilles, they were deposited on the vertical walls of tanks, and, in a state of nature, are probably deposited in places similar to those used by *G. paganellus*.

GOBIUS MINUTUS, L.

Professor Collett has called our attention to his description of examples of *G. minutus* from 50 to 280 metres (about 27 to 153 fathoms) in various Norwegian fjords,† and suggests that the pale deep-water forms, to which we made brief reference in the Report for 1901,‡ may be of the same character. The Norwegian forms are described as from 50 to 62 mm. in length. The whole of the throat is scaleless, and the body and fins are very pale. The author considers that they ought possibly to be referred to a sub-species ("Underart"), for which he proposes the name *norvegicus*.

The sub-species seems rather imperfectly defined, and though our examples may very probably resemble the Norwegian forms, we do not for the present consider that there is evidence of the existence of a well-marked deep-water race in British and Irish waters.

* In the Mediterranean, *e.g.* at Marseilles, where there is no considerable rise or fall of tide, young specimens are common in the shallow pares used for storing shell-fish, but the big ones seem to live mostly outside among rocks which never uncover.

† Meddelelser om Norges Fiske, I., 1902, pp. 53, 54.

‡ Pp. 51 and 63 (p. 15 of reprint.)

III.—FIGURES AND DESCRIPTIONS OF THE BRITISH AND IRISH SPECIES OF *SOLEA*.

BY

E. W. L. Holt and L. W. Byrne.

Plates XXIX. to XXXIV.

The following notes are not addressed to ichthyologists but to those who, without professing a special knowledge of fishes and without the aid of a library, may be called upon to record the result of fishing operations. Except that Miss Woodward's figures are original and that the diagnoses have been verified by personal observations, we offer little that cannot be found in the copious literature of the subject.

References and synonomy we have restricted to the absolute minimum, but readers may be here referred for coloured figures of most of the species to Cunningham's "Treatise on the Common Sole." Life-history, habit, habitat, and distribution are treated very briefly, but sufficiently, we hope, to attract the attention of those who may find material for the increase of knowledge in these particulars.

We use the term "British and Irish" in the compound sense, and not as denoting any distinction in the Marine Fauna of the waters surrounding the different parts of the British Islands. For marine zoological purposes such a distinction does not appear to us to be yet warranted by completeness of survey.

It is perhaps necessary to note that the genus *Solea* does not include a number of fishes which are commonly spoken of and sold as soles.

The "white sole" of Irish fishmongers, "witch" of England, and "craig fluke" of Scotland is a fish of the dab kind, termed by naturalists *Pleuronectes* (or *Glyptocephalus*) *cynoglossus*. Neither in anatomy nor flavour has it any near kinship with the true soles. Another dab, *Pleuronectes microcephalus*, is known in England as "lemon sole,"* "merry (Mary) sole," or "cock sole," and though known to the older generation of Dublin trawlers as "smear dab," is now commonly sold in Ireland as "white sole" or "lemon sole," according to the fancy of the vendor. Like the preceding, it is an excellent fish, but not a sole.

Rhombus (*Zeugopterus*) *megastoma*, "megrim" or "merrygrim" in England, "sail-fluke" in Scotland, "witch" or "megrim" in the parlance of Irish fishermen, not infrequently becomes a "white sole" before it reaches the Irish consumer, and it may be supposed that its deep-water relative, *Rhombus Boscii*, now brought within reach of the market by modern methods of trawling, will equally lose its identity before appearing at table.

Terminology.

We have endeavoured, as far as is compatible with concise description, to avoid the use of technical terms, and most of those which we have been compelled to use are illustrated in the figure of the adult *Solea vulgaris*.

The following points should be borne in mind when dealing with the descriptions of species, and, taken with the figure above allnded to, should make the descriptions given sufficiently intelligible.

The *depth of body* is measured at the deepest part of the fish, and is exclusive of the dorsal and anal fins; the *total length* is measured from

*The name "lemon sole" is applied in some natural history books to *Solea lascaris*, but we do not believe that the fish ever enjoyed such a designation elsewhere.

the front of the head to the origin of the caudal fin; the *length of head* is measured from the front of the snout to the posterior point of the opercular bone of the gill cover and does not include the skinny flap which forms the extreme edge of the gill cover. The *depth of caudal peduncle* is measured at its lowest point. The *snout* is the distance from the front of the head to the level of the front margin of the eye of the ocular side (*i.e.* the lower eye); the longitudinal diameter of the *eye* is taken from that of the ocular side unless otherwise stated, and this measurement is always greater compared to the length of the head in the young than in the adult. The *interorbital space* is measured between the inner margins of the bony orbits, the *interocular space* between the exposed parts of the eyes.

It is necessary to observe that in the soles the proportions are very variable in the living fish, and are liable to considerable alteration by the action of preservatives and by ordinary *post mortem* shrinkage. The proportions given in the diagnoses of species must, therefore, be regarded as merely approximate, and must not be treated as absolutely reliable, by themselves, for specific determination.

The scales are counted (1) in a longitudinal series from the posterior end of the operculum to the origin of the caudal fin, parallel with and above the lateral line*; (2) in a transverse series across the body so as to give the number of longitudinal series above and below the lateral line; their number is expressed conventionally, thus Sc. 150, 45/50, indicates 150 scales in a longitudinal series and 45 longitudinal series above and 50 below the lateral line at the deepest part of the body. The tranverse series may be counted either vertically, passing in zigzag fashion from one longitudinal series to another; or, with greater ease, in a single oblique row passing through the lateral line at the thickest part of the body. In either case the resultant number is about the same. Both methods are illustrated in Pl. XXIX., but, owing to the difficulty of deciding the part of the skin which masks the origin of the fin rays, exact counting of the scales is especially difficult when the fish is fresh, and no attention need be paid to small discrepancies of number.

Generic Characters.

The true soles found in European waters differ from other flat fishes of the same region in that the margin of the head projects in front of the mouth. The mouth is also more distorted towards the blind side of the body than in other forms, and the jaws, which bear teeth only on the blind side, are strongly curved. To a greater or less extent the front part of the blind side of the head bears tufts of short filaments; these appear to have a tactile function, and serve to assist in the finding of food, and their different arrangement in different species is sometimes useful as a means of identification. The scales on both sides of the body are small, horizontally elongated, deeply overlapping, and ctenoid (*i.e.*, beset with spinous processes), and the rays of the marginal fins are scale-clad on both sides.

The form of the body is more elongate than in most other flat fish, and the dorsal and anal fins are separated from the caudal by an unusually small interval, presenting an approach to the condition of some exotic flat fish (*e.g.*, *Cynoglossus*), in which the dorsal, caudal, and anal fins are continuous. The dorsal fin has its origin far forward on the head. The pectoral fins, in no case of any considerable size, are, in the sub-genus *Solea* (sole and sand-sole), of about the same size on either side of the body, while in the sub-genus *Microchirus* (thick-back, *Solea profundicola* and solenette) the pectoral fin of the blind side is reduced to a mere vestige.

All true soles are dextral, *i.e.*, the eyes of the adult are on the right side of the head, and, though it is not impossible that such variation may occur, we do not recollect to have heard of a reversed specimen.

* In some fishes the scales of the lateral line itself are enlarged and do not correspond to those above and below it.

We have seen one example in which the eye of the left side retained its original position in the adult, though in other respects, including the torsion to the right side of the upper parts of the skull, the fish was practically normal.

The blind side is normally devoid, or practically devoid, of pigment, but instances of what is termed partial ambicolouration are not very rare in the common sole, and occur, no doubt, also in other species.

The eggs of the Soles are pelagic, *i.e.*, they are of less specific gravity than the sea water, and consequently float, not necessarily at the surface, though in the more saline water of the Mediterranean they appear to be commoner in the superficial layers than in our seas. They possess certain characters in common throughout the genus, viz., the *zona radiata*, or shell, is devoid of any conspicuous markings; the yolk is transparent, devoid of colour, and covered by a superficial layer of vesicular segments, while throughout the periphery are scattered a large number of small oil-globules, never restricted to any particular region and never coalescing into one or any small number of large globules.

The embryo is decorated with yellow (of various tints according to species), and later with black pigment, and the larva, during its symmetrical stage, is characterised by the prominence of the mid-brain and by the presence of a more or less pronounced "float" or ampullation of the primordial fin-membrane above the head.

After the absorption of the yolk the larva passes through the normal phases of pleuronectid metamorphosis. The body gradually deepens, while the upper part of the head becomes gradually twisted to the right side until both eyes come to be situate on the same side. Since the contrary has been stated by Smitt, whose edition of the "History of Scandinavian Fishes" commands a deservedly high respect, it may be noted that in the species of *Solea* of which we have knowledge the left eye passes the ridge of the head before the dorsal fin has extended so far forward, and therefore does not pass under that fin (or *apparently* through the tissues of the head) as in *Plagusia*, and, among British fishes, *Arnoglossus*.

Adult soles, like other flat-fishes, have no air-bladder; and, though provided with this organ, the larval sole is, unlike the corresponding stages of the Turbot and Brill, very seldom met with in our seas at the surface.

SOLEA VULGARIS, Quensel.

Sole, Black Sole (Common Sole *auct*)

Pls. XXIX. and XXXI

For an exhaustive bibliography see Petersen, *The literature of the ten principal food fishes of the North Sea*, Copenhagen, 1903.

Depth of body in young about $2\frac{3}{4}$ to 3 times; in adults about $2\frac{1}{3}$ to $2\frac{5}{6}$ times in total length (without caudal fin), but very variable, and exceptionally somewhat less; length of head about $4\frac{1}{2}$ to about $5\frac{1}{2}$ times. Depth of caudal peduncle about $3\frac{1}{2}$ to $5\frac{1}{4}$ times in depth of body. Eyes about equal in size, about $5\frac{1}{2}$ times (in adult) to about $4\frac{1}{2}$ times (in young) in length of head, the upper about half its diameter in advance of lower; interorbital space less than, interocular space (in adult) rather greater than longitudinal diameter of eye. Snout about as long as, often longer than, eye. Nostrils of ocular side close together, both tubular, the anterior reaching back nearly to the eye, the posterior with a short tumid tube; anterior nostril of blind side tumid but not greatly expanded nor conspicuously fringed.

Dorsal fin with about 75 to 90 rays. Anal with about 65 to 80. Pectoral fin of ocular side about two and a half times in head, of blind side as long, or nearly as long, as that of ocular side. Caudal fin $\frac{1}{8}$ to $\frac{1}{11}$ of length inclusive of such fin. Scales about 130-160, 40-50/50-60.

Anterior part of blind side of head, about as far back as a tranverse line passing some way behind the angle of mouth, beset with tufts of short filamentous processes, which are continuous in distribution, and without any conspicuous linear or reticulate arrangement. The filamentous region is continued some way back along the dorsal and ventral margin, and some of the anterior dorsal and anal rays have small filaments on the basal parts of their posterior edges.

Caudal peduncle exceedingly short, there being hardly any interval between the last of the dorsal and anal rays and the upper and lower caudal rays. Indeed, the membrane of the last dorsal and anal rays may extend some way on the scale-clad basal parts of the caudal rays.

Colouration of ocular side during life subject to variation, specimens taken on dark ground being of a darker, and on light ground of a paler brown or yellowish brown general colour. The markings consist of darker blotches of varying sizes, which are roughly arranged in three longitudinal rows with less marked rows between them, and of small pale spots, which are irregularly arranged in the intervals between the dark blotches. The unpaired fins have a very narrow border of dead white. There is a roughly elliptical dark spot at the distal end of the pectoral fin of the ocular side, never enclosed in a white ring. Within a short period after death the differences of shade observable in life in specimens from different grounds disappear, being due to temporary conditions of expansion of chromatophores rather than to actual differences in the colour elements, and the ocular side becomes of a uniform dark cold sepia brown.

It is said to attain a length of 26 inches, but specimens exceeding 19 inches are rather rare. In general soles from the S.W. of England and S. and S.W. of Ireland are larger than those from other parts of our coasts. The weight has been said, on apparently reliable authority, to reach 6 lbs., but does not usually exceed about 3 lbs. The female is sexually mature at about 12 inches, the male at about 10 inches. The testes, even when ripe, are much smaller than in the males of other common Pleuronectids, and their inconspicuous condition when immature or unripe has given rise to the popular idea that male soles are very rare. So far as is known there are no marked external differences between the sexes, but the female grows to a larger size and is more abundant than the male. The young, as apparently in all soles, are comparatively more elongated than the adults, and the body appears to grow relatively deeper with age, while the head becomes proportionally shorter.

The sole is unknown in Arctic waters, rare on the Norwegian coast and the Färoes; it is uncommon on the north-east coasts of Scotland, but grows rapidly more plentiful south of the Firth of Forth, and its distribution on the Danish and Dutch coasts is similar. In the off-shore part of the North Sea it is absent or of no great commercial importance on and to the north of the Dogger. It is common in the English Channel and on all the coasts of Ireland (except the north-east), and extends to the south and east into the Mediterranean. It is absent from American waters.

The sole is essentially a shallow water fish, and, when adult, is commonly found in water from 5 to 40 fathoms depth; less commonly in deeper water, down to about 60 fathoms, except in winter, when, in the North Sea, it has been known to frequent the "Silver Pit," about 50 fathoms deep, in great numbers. We are not aware of any records below the 100-fathom line, excepting that of Vaillant of a specimen taken on the Banc d'Arguin in 235 metres. The young, from the assumption of the adult form up to a length of 5 or 6 inches, appear to chiefly favour estuarine and littoral waters, and are suspected by fishermen to hibernate to some extent in the sand during winter. There is no direct evidence for or against this theory; nor is there evidence of a definite off-shore migration of young soles in the winter; but ordinary methods of open sea fishing are little calculated to throw light upon this. It is probable there is a limited migration of adults in the spawning season into waters of 25 or 30 fathoms depth, and there is undoubtedly concentration of spawners on certain grounds at this season. Many fish, however, appear to spawn in shallower places. On some parts of the coast there is in the late spring, summer, and autumn, according to locality, a distinct

migration of adults into estuaries and shallow bays, &c., but the fish go sea-ward again before winter. In the partly estuarine habitat of both young and adults the sole differs from its congeners of our coasts.

In British and Irish waters spawning takes place in the spring and summer, most commonly in March and April, and only occasionally later than June. The number of eggs produced by a single female has been estimated from 750,000 in the case of a large fish to 100,000 in small fish.

Soft ground, fine sand, sandy mud, or mud,* are normal haunts of the sole at all seasons, perhaps especially where such bottom occurs in the neighbourhood of small reefs, patches of rocks, or rough ground, while coarse sand and gravel, too rough for trawling, undoubtedly harbour a fair number in summer, if not, generally, at other seasons. Temporary emergence from such a bottom on to neighbouring ground suitable for trawling may possibly in many cases furnish the true explanation of a phenomenon usually ascribed to lengthy migration.

The food, which is very largely composed of Annelids, and to a less degree of Echinoderms (mainly *Amphiura*), Lamellibranchs, Crustaceans (chiefly Gammarids), Gastropods (*Philine*), Gephyreans, and fishes (*Crystallogobius* and sand-eels), appears to be taken entirely on the ground. When in search of food, at any rate in captivity, the sole seems to rely very largely on its sense of smell, and to a less degree on that of touch, searching the bottom apparently with the filaments of the under side of the head, and immediately seizing any edible substance which it finds. To a fish with such habits the sense of sight can be of but small assistance in its search for food. Bateson's† investigations showed that the sole fell into the category of fishes which find their food primarily by smell, and the large development and peculiar situation of the anterior nostril of the blind side seem hardly explicable on any other hypothesis. That author states that the filamentous processes of the under side of the head bear no sense organs, but cites Cunningham's authority for the statement that there are sense organs on the surface of the head in the areas covered by them.

Both observations on captive specimens and the general experience of fishermen point to the sole being a nocturnal feeder, at any rate in shallow water.

It is taken occasionally in seines, tuck-nets, and trammels, but sole-fishing for commercial purposes is practically confined to trawling; and it would appear that the most suitable instrument for its capture is a beam trawl with a heavy ground rope worked by night. At Scarborough, and perhaps at some other places, a considerable number of soles are caught in the autumn on long lines with small hooks on gut snoods, baited with "eskers" ("rag-worm," *Nereis* sp.).

The eggs have the general character noted in our remarks on the genus, and are specifically characterised—(1) by the presence of very numerous, exceedingly minute oil-globules, mostly arranged in dense masses, which do not coalesce before the hatching of the larva; (2) by the coloured pigment of the embryo and larva, which consists of pale dull yellow chromatophores, appearing brown by transmitted light, and, in smaller number, of black chromatophores; (3) by the diameter, which is about 1 to 1·58 mm., the dimensions probably depending to some extent on the size of the parent.

The larval sole on hatching is about 3 to 3·7 mm. in total length. The chromatophores already noted are sporadically distributed, extending on to the marginal fins and over the yolk as well as on the head and body. The black chromatophores, much fewer in number, are also generally distributed, but the pigment elements of both colours soon tend to arrange themselves in a series of large conspicuous blotches, but not in definite transverse bars. Before the absorption of the yolk the mid-brain becomes remarkably prominent, and the dorsal fin-fold is ampullated to a varying degree above the head. The snout from the first

* The "mud" of soundings is often muddy sand, and it is to such material, and not to the slimy mud of certain bottom deposits, that our remarks refer.

† M.B.A., Jour., N.S. 1., 225.

projects somewhat in front of the yolk-sac.* The larva appears to the naked eye of a pale brown colour, and is exceedingly active. At a length of about 4 mm. the mouth is functional. At a length of about 11 mm. the left eye is almost on the ridge of the head, and the dorsal and anal fin-rays have appeared, while at a length of from 12 to 15 mm. much of the general appearance of the adult is assumed, the final stages of the metamorphosis being rapidly passed through. The habitat of the metamorphosing larvae is not certainly known, but between 7 and 11 mm. the larvae are to some extent pelagic, and may normally swim in mid-water or at no very great distance above the bottom; they have been taken in bottom tow-nets in water of no great depth, and less frequently at the surface; but for whatever reason specimens at this stage are not commonly met with. They feed, to a large extent, on the larvae of other fishes.

The culture of soles cannot yet be said to have reached a practical stage, but considerable advance has been made in this direction by MM. Fabre-Domergue and Biétrix, who have succeeded in rearing the young through the larval stages. The practical application of their methods must depend, we suppose, not only on consideration of expense but upon a reasonable assurance of adequate protection of the young from destruction by long-shore fisheries after they are turned out of the hatchery.

Young soles, for reasons seen above, seldom come into the hands of any but long-shore fishermen, but the small species, *Solea lutea*, which occurs on off-shore grounds, is quite commonly mistaken for a young *Solea vulgaris*. We have, therefore, asked Miss Woodward to draw for us a specimen of the latter of a size comparable to the adult solenette, and pl. XXXI. will be found to explain the distinctions sufficiently. The difference in shape and in the size of the scales is apparent, while the dull greyish-brown of the young sole (young soles are hardly so dark as the adults) is quite different from the pale reddish or yellowish-brown of the solenette, and the black streaks of the marginal fins of the latter present a further obvious distinction.

It is perhaps worth mentioning that the sole is the fish which stands most in the way of any regulation dealing with the mesh of nets used for the capture of flat fish. Whereas a plaice may be caught in a net the mesh of which, by appeal to measurements, would appear to afford ample opportunity of escape, a sole will wriggle out of any hole large enough to let it through. A small mature sole is narrower than an immature plaice, and is, if anything, more valuable per pound than a large sole.

As compared with its congeners and with other flat fishes, the sole is a fish of extraordinary vitality, surviving removal from the water and retaining its muscular strength for a considerable time. It is, however, at least in aquaria, extremely subject, as first remarked by Fulton, to fatal inflammation arising from abrasion in the net. This susceptibility to wounds, which in other forms, plaice and flounders for instance, heal rapidly, may account for the want of success which, we understand, has attended attempts to study its movements and migrations by means of labels affixed to captured specimens. Moreover, while the scales of the blind side of a plaice (so successfully marked by Fulton, Kyle, and Garstang) are mere dermal armature, those of the sole are organs of prehension and locomotion, as anyone may ascertain by trying to pull a live sole, tail first, along the deck of a vessel. The affixing of a label† may consequently be a serious interference with the activity of the sole so honoured.

The liability to inflammation may possibly be a cause contributing to the present scarcity of the species if small fish which have successfully struggled through the meshes of a net often subsequently succumb in nature to the abrasions contracted in their escape.

From the observations of one of us, soles appear rather liable to a functional derangement of the excretory organs, whereby the urocyst may

* Petersen, in the compilation referred to above, reproduces a number of drawings of the egg and larval stages.

† The labels used are bone discs placed on either side and connected by a silver wire passing through the muscles of the fish.

become completely impacted with polygonal masses, some as large as a pea, of a hard white substance, presumably uric acid in solid form.

An external parasite of the sole, *Phyllonella soleae*, is fairly familiar; it is a Trematode worm of the family *Tristomatidae*, flat and semi-transparent in appearance.* A parasite less generally known, but not uncommon on the Irish coast, is the leech *Hemibdella soleae* (van B. and H.)†, a thin dark-brown creature which sometimes clings to the ocular side in such numbers as to make fishermen say that the fish is covered with hair. Another and much larger leech, *Branchellion*, appears, from the British Museum catalogue, to have been found on soles, but it is certainly rare on them, as, indeed, on any fish of our coasts. *Platybdella soleae* (van B. and H.), recorded from British waters by T. Scott, is probably generally unobserved on account of its small size.

SOLEA LASCARIS, Bonap.

Synon. *Solea aurantiaca.*

SAND SOLE, FRENCH SOLE (LEMON SOLE, *auct.*).

PL. XXX.

Depth of body about $2\frac{1}{3}$ or $2\frac{1}{2}$ times in total length, exclusive of caudal fin, length of head about five times. Depth of caudal peduncle about $4\frac{1}{2}$ or 5 times in depth of body. Eyes nearly equal in size, about $4\frac{1}{2}$ times in length of head, the upper about half its diameter in advance of lower; interorbital space narrow, interocular space about twice in snout, which is about half as long again as eye. Anterior nostril of ocular side tubular, anterior nostril of blind side very large and dilated, with numerous radial folds running from its aperture to its outer margin, which is distinctly fringed with short processes.

Dorsal fin commencing in front of upper eye, with about 79 to 89 rays, anal fin with about 67 to 70 rays. Pectoral fins of equal, or nearly equal, size, about $2\frac{1}{2}$ times in length of head Caudal fin about $\frac{1}{10}$ of length inclusive of such fin. Scales about 110-130, 30-34/37-40. Short filamentous processes along the upper and lower margins of the blind side of the head and opercular bones, round the mouth and nostrils, and in six or seven narrow roughly vertical bands from the upper margin of the head to its middle line.

Colouration in life brownish or greenish-yellow with numerous small blackish blotches and specks which may form larger or smaller groups, and scattered bluish or greyish spots. There is a conspicuous horizontal black band on the pectoral fin of the eyed side, usually completely enclosed by a white margin. After death the ocular side is of a pale yellowish or reddish-brown, with more or fewer small black markings. It never becomes of an uniform dark brown, as in *S. vulgaris*. Blind side opaque white.

The length does not appear to much exceed twelve inches. A male eight inches in length was mature.

In British waters the records of distribution are (probably from failure of recognition) too meagre to admit of satisfactory tabulation, but the species appears to be nowhere very abundant. It has been observed in the Southern part of the North Sea, in the English Channel, in the Irish Sea, in Blacksod and Clew Bays, County Mayo, and Dingle Bay, County Kerry, and is locally not uncommon on the south coast of Devonshire. It should be looked for among soles taken from shallow water. The pale colour of dead specimens attracts the eye, and the huge anterior nostril of the blind side at once settles the determination. Sand and fine sand appear, to our limited knowledge, to be favourite haunts, while Plymouth

* See Cunningham, *tom. cit.*, p. 93.

† We are indebted to Dr. E. R. Blanchard for the determination of this species.

trawlers have told us that they usually get a few pairs on the coarser part of the Mount's Bay ground. In Dingle Bay Mr. Farran has taken the species on ground of which at least a part was coarse sand.

On our coasts one bathymetric limit is presented in the summer by the extreme margin, and we cannot place the other limit deeper than twenty-four fathoms (Dingle Bay, March) at any season, though it seems probable that the fish is only found in very shallow water during the warmer months of the year.

Geographically, our islands form the northern limit of distribution. Southwards the range extends as far south as Madeira and into the Mediterranean at least as far east as the coast of Italy; but over this area there is considerable lack of continuity in the records which we have been able to find; and beyond some intrinsic evidence of a generally deeper haunt we have no information of the bathymetric distribution in southern latitudes.

The spawning season appears to be somewhat later than that of the common sole. The eggs and larvae are not known with certainty, but ova taken in the tow-net at Marseilles and on the west coast of Ireland may, with great probability, be referred to the sand sole. They are somewhat smaller than those of the common sole, the diameter being about 1·36 to 1·38 mm. The arrangement of the oil-globules is much as in *Solea vulgaris*, but the minute globules are less numerous, and there is a greater tendency to coalescence during development *in ovo* than in that species. The coloured pigment of embryo and larva is of a bright gamboge yellow by reflected light; and the ampullation of the fin-fold over the head of the larva is more pronounced and more forwardly directed than in the larval common sole.

SOLEA AZEVIA, Brito Capello.

This species is not a native of the British and Irish area, but, as appears below, is brought to British markets.

"The manager of the fish department at Harrod's Stores, who is "always on the look-out for uncommon specimens, has shown me "examples of a sole which, apparently, has not been seen before in the "London market. This is *Solea azevia*, first described by Brito Capello "from the coast of Portugal, and since also found in the Canary "Islands. An excellent figure of this fish has been given by the "Austrian ichthyologist, Dr. Steindachner, in 1868, but was regarded "by this distinguished authority as a variety of our common sole. "But *Solea azevia* is quite a distinct species, differing in the larger "scales (100 to 120 in a straight line from the head to the caudal fin), "in the larger and more truncate caudal fin (measuring about one-sixth "of the total length), which is separated from the dorsal and anal fins "by a space equal to one-fourth or one-third of the length of the head, "and in the colouration. The coloured side is uniform brown; the "dorsal and anal fins are brown on the scaly part, otherwise purplish "grey, with the tips of the rays white; an orange line runs along the "fins, on the purplish-grey part; the pectoral fin is tipped with blackish, "but less conspicuously than in our common sole. In the shape of the "tail this sole resembles the thickback (*Solea variegata*), which differs, "among other points, in the very minute pectoral fin. *Azevia* is a "Portuguese name used for the sole at Lisbon."—G. A. Boulenger. *Field*, CIV., 1904, 15th Oct., p. 692.

Notice of this fish was received too late to allow of the inclusion of a drawing and full description in this paper. We hope to deal fully with the species in the next Report.

SOLEA VARIEGATA, Don.

Thickback (Variegated Sole, *auct.*).

Pls. XXXIII. and XXXIV.

Depth of body, $2\frac{1}{2}$ to 3 times; length of head, $4\frac{3}{4}$ to $5\frac{1}{2}$ times in total length, exclusive of caudal fin; depth of caudal penduncle, about 4 times in depth of body. Eyes nearly equal in size, 5 times (in adult) to less than 4 times (in young) in length of head, the upper eye about one-third of its length in advance of the lower; interorbital space narrow, interocular space (in adult) about equal to longitudinal diameter of eye; snout as long as, or slightly longer than, eye. Anterior nostril of ocular side tubular, reaching back nearly to eve; anterior nostril of blind side somewhat tumid. Dorsal fin with about 63 to 74 rays, anal with about 52 to 58. Pectoral fin of ocular side as long as, or but little longer than eye, of blind side, vestigial. Caudal fin about $\frac{1}{6}$ or $\frac{1}{7}$ of length inclusive of such fin. Scales about 85-105, 20/23-24.

Filamentous processes present on the anterior part and along the dorsal and ventral margins of the blind side of the head. Ground colour of ocular side brown, usually with a reddish or chestnut tinge, with about five well-marked darker transverse bands and sometimes with less conspicuous bands in the intervals between them; these bands terminate in dark patches at the base of the marginal fins, which extend along the fin rays; caudal fin with a dark transverse band. Although the system of marking is constant the bands vary much in intensity; sometimes the dark marginal patches only are visible, and this is perhaps the most usual condition in large examples. Blind side pinkish white. Attains a length of 220 mm. (nearly nine inches), and is sexually mature at about six or seven inches.*

On our coasts the thickback affects deeper water than either of the preceding species. We do not know of its having been taken in less than ten, and it is certainly rare in less than twenty fathoms. From that depth to fifty fathoms appears to be its usual haunt, but it descends to at least 160 fathoms.

It is by no means uncommon at the western end of the English Channel on fine or coarse sand, and is at times abundant on the trawling grounds outside the Eddystone and in Mount's Bay. It occurs (and may probably be common at suitable depths) on the south-west and west of Ireland, but not on the east coast. It has been taken in the outer part of the Firth of Clyde, and, according to Fulton, in the Moray Firth, but we have no record of its capture in any other part of the North Sea nor in the eastern part of the Channel. Plymouth, so far as we are aware, is the only British market in which the thickback occupies a recognised commercial position.

Southwards it is found in the Bay of Biscay and in the Mediterranean.

Spawning commences in the Channel in the early spring, and appears to continue throughout the spring and summer. Cunningham found spawners at thirty to forty fathoms south of the Eddystone in April, and the eggs, recognised from his description, are of not infrequent occurrence in tow-nets over the same area.

The ova are from 1·16 to 1·36 mm. in diameter, and are further distinguished from those of the two preceding species by the absence of groups of very minute oil-globules. The oil-globules are numerous (thirty-eight have been counted in one instance), small (about ·03 to ·11 mm.), and distributed separately and irregularly over the surface of the yolk. The newly-hatched larva is about 2·42 mm. long; its coloured pigment is lemon-yellow by reflected light.

The metamorphosing larva is distinguished by well-marked bars of black chromatophores. It does not appear that the larval and young stages differ in bathymetric distribution from the adult.

* We make this statement from eye observations only. It must consequently be accepted with reserve.

SOLEA PROFUNDICOLA, Vaillant.

Synon. *Solea Greeni*, Günther.

PLATE XXXII.

Depth of the body $2\frac{3}{4}$ to 3 times in total length exclusive of caudal fin. Length of head $5\frac{1}{4}$ to $5\frac{3}{4}$ times. Depth of caudal peduncle $3\frac{3}{4}$ to $4\frac{1}{2}$ times in depth of body. Eyes nearly equal in size, the upper slightly in advance of the lower; longitudinal diameter of eye 4 to $4\frac{1}{2}$ times in head. The lower eye is rather more tumid and more covered with skin than the upper. Snout longer than eye, $3\frac{1}{2}$ to $4\frac{1}{4}$ times in head. Interorbital space narrow, interocular space less than length of eye. Anterior nostril of ocular side tubular, of blind side slightly tumid.

Dorsal fin with about 80 to 90 rays, anal with about 65 to 75. Pectoral fin of ocular side varying in length in different individuals, never much exceeding eye in length, often much shorter than eye; pectoral fin of blind side vestigial, about half as long as eye. Caudal fin 8 to 10 times in length inclusive of such fin.

Scales 125-140, 30-35/34-42. Filamentous processes present on anterior part of and along dorsal and ventral margins of blind side of head.

Colouration of ocular side during life rich fawn, with a series of five or six indistinct paler roundish areas near the dorsal and ventral margins; about four similar pale areas may be present in the region of the lateral line. The pale areas rapidly disappear after death, leaving the ocular side of an uniform colour. Pectorals and ventrals of both sides blackish grey; membrane of marginal fins also blackish grey on both sides, with a narrow white margin. Blind side opaque, slightly yellowish white, excepting the paired fins, the membranes of the unpaired fins and the opercular border, which are all blackish grey. Mucous membrane of mouth and gill cavity also blackish grey. After preservation in alcohol the ocular side is uniform brownish grey.

Attains a length of 20·5 cm. (about $8\frac{1}{4}$ inches); the specimen figured measures 18·7 cm. ($7\frac{1}{2}$ inches) and is an adult female.

S. profundicola is an inhabitant of deep water, and its known range extends from the S.W. of Ireland to a little south of the Canaries, and vertically from 135 to 750 fathoms. Of twenty-one specimens known to science, all but five have been taken off the S.W. of Ireland, one, figured in Pl. XXXII., by the *Flying Fox* in 1889, in 150 fathoms forty-seven miles west of the Bull Rock, the second by H.M.S. *Research* in July, 1889, in 217 fathoms in lat. 49°5′ N., long. 11°15′ W., and the remainder by the *Helga* in November, 1904, and February, 1905, at 320 to 337 fathoms, 48 and 50 miles off Tearaght Lt. The five type specimens were taken by the *Travailleur* and *Talisman* at various localities and depths off the Portuguese coast, in the Gulf of Cadiz and off Cape Bojador, in from 135 to 705 fathoms of water.

In the light of the further material now available, we are able to confirm the suggestion formerly made by one of us* of the identity of *S. Greeni*, Gthr. with *S. profundicola*, Vaillant.† All the latter author's specimens were in a very damaged condition, and we have only had an opportunity—kindly afforded us by Mr. G. A. Boulenger—of examining one of them; but a comparison of this specimen and Vaillant's original description with the Irish specimens leaves no reasonable doubt of the identity of the two species. Vaillant's printer is probably to blame for the statement with regard to the eyes that "*leur diamètre est d'environ ⅔ de la longueur de la tête*," which is not borne out either by the specimen examined or the author's table of measurements, in which the diameter of the eye is given as rather more than ⅕ of the head, or nearly the same as in the Irish examples. He also gives the scales as "31/127/49"; possibly 49 is another error, but, in any case, in the damaged specimen examined by us, such scales as were left agreed with those of the Irish specimens examined, and we cannot regard the difference between a formula of 125-140, 30-35/34-42 in five specimens and 127, 31/49

* Sci. Trans. R. Dub. Soc., s. 2, V. p. 508 (1895).
† Ex. Sci. Travailleur et Talisman, Poissons, p. 190 (1888).

in one other as sufficient to support the specific separation of the Irish specimens from the Portuguese and North African ones in the face of their almost absolute agreement in every other material respect.

SOLEA LUTEA, Bonap.

Synon.—*Solea minuta.*

SOLENETTE.

PLATE XXXI.

Depth of body, about $2\frac{1}{2}$ to 3 times; length of head, about $4\frac{1}{2}$ times or rather less in total length, exclusive of caudal fin; depth of caudal peduncle, about 4 times in depth of body. Eyes nearly equal in size, 4 to $4\frac{1}{2}$ times in length of head, the upper about $\frac{1}{2}$ its diameter in advance of the lower; interorbital and interocular space narrow, the latter about $\frac{1}{2}$ longitudinal diameter of eye; snout slightly longer than eye. Anterior nostril of ocular side tubular, anterior nostril of blind side somewhat tumid. Dorsal fin commencing in front of lower eye, with about 65 to 77 rays, anal fin with about 50 to 63 rays. Pectoral of ocular side slightly longer than eye, about 4 times in head; pectoral of blind side vestigial. Caudal fin about $\frac{1}{6}$ or $\frac{1}{7}$ of length inclusive of such fin. Scales about 62-72, 19-22/22-25. Filamentous processes on anterior and lower part of blind side of head arranged in a roughly reticulate pattern, with small interspaces.

Sandy yellow or ochreous brown in colour with dark brown blotches roughly arranged in longitudinal series, and small scattered bluish or grey spots; unpaired fins with most of their rays ochreous or reddish-brown, but about every sixth or seventh ray black for the whole of its length, giving the fish a very characteristic appearance. Blind side white, often slightly tinged with red or brown. Attains a length of about 120 mm. ($4\frac{3}{4}$ in.). The female attains maturity at a length of 70 mm. ($2\frac{3}{4}$ inches) or less, and the male apparently at an even smaller size. There are, so far as is known, no external differences between the sexes.

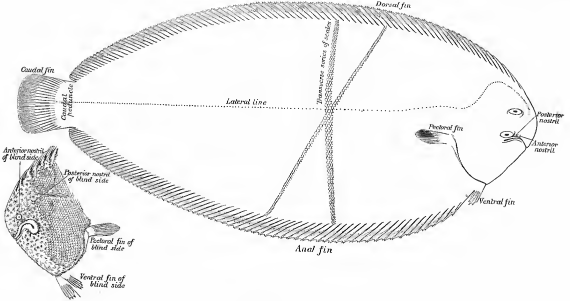
Solea lutea is found on all the British and Irish coasts, but appears to be more abundant in the south and west than in the north and east, though, locally, not uncommon in the North Sea. Southwards its range extends into the Mediterranean and northwards to Norway. In spite of a not infrequent confusion with the young of the common sole—from which it may be immediately distinguished by the vestigial pectoral fin of the blind side, the larger scales, and the characteristic colouration of the marginal fins—it appears tolerably certain that the solenette is confined on our coasts to water of less than forty fathoms depth, commonly to depths of from five to twenty fathoms, and with a bottom of sand. In the south and south-west of our islands and in the Irish Sea it seems to be abundant in all suitable localities that have been fished with gear capable of effecting its capture, but it appears to be less abundant further north.

Its food and habits, so far as they are known, resemble those of the common sole; but, unlike the latter, it does not frequent estuaries. There is no evidence of any marked migration at any time of the year or at different periods of its growth; in fact, so far as our experience goes, it is found on much the same ground at all seasons of the year, and at all stages.

Spawning takes place in June and July, and less frequently in April and May.

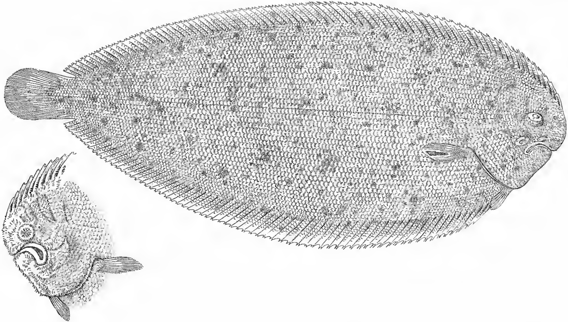
The ova are ·64 to ·88 mm. in diameter, and in general characters resemble those of the thickback, but the segmentation of the outer zone of the yolk is particularly conspicuous in the earlier stages of development.

The newly-hatched larva is about 2 mm. in length, and is characterised by the presence of pigment of a bright orange colour (brown by transmitted light), by the forward prolongation of the fore-brain, and (as development proceeds) by the prominence of the mid-brain.



Solea vulgaris, adult, $\times \frac{2}{5}$.

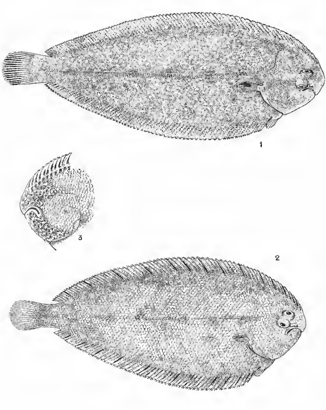
G. M. Woodward del



Solea lascaris $\times \frac{5}{6}$.

G. M. Woodward del.

Pl. XXXI.



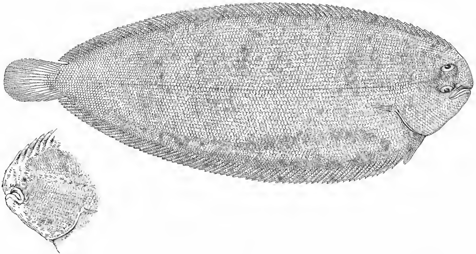
G. M. Woodward del.

1. Solea vulgaris, young, $\times \frac{5}{6}$.

2 & 3. Solea lutea, $\times \frac{5}{6}$.

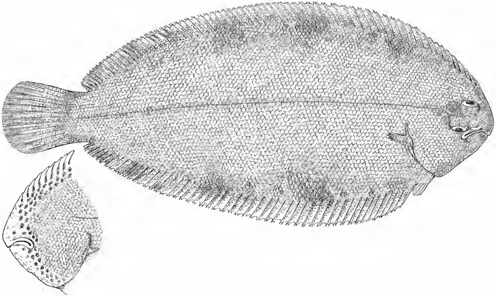
B

Pl. XXXII.



Solea profundicola, $\times \frac{5}{6}$.

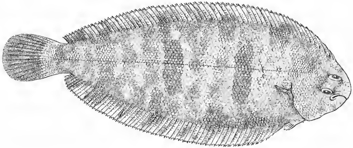
G. M. Woodward del.



Solea variegata, × $\frac{5}{6}$.

G. M. Woodward del.

PI. XXXIV.



G. M. Woodward del.

Solea variegata, $\times \frac{5}{6}$.

KEY TO SPECIES OF *SOLEA*.

I. Pectoral fins of botb sides well developed and far longer than eye.

a. Caudal fin not exceeding $\frac{1}{8}$ of lengtb including such fin. Caudal peduncle exceedingly short.

a. i. Pectoral of ocular side with a terminal black patch. Anterior nostril of blind side tubular and inconspicuous.

S. vulgaris.

a. ii. Pectoral of ocular side with a longitudinal black band usually surrounded by a wbite margin. Anterior nostril of blind side very large and stellate.

S. lascaris.

b. Caudal fin about $\frac{1}{6}$ of length including sucb fin. Caudal peduncle $\frac{1}{3}$ or $\frac{1}{4}$ of length of head.

S. azevia.

II. Pectoral fin of blind side vestigial and muoh shorter than eye.

a. Moutb subterminal and snout not projecting far in front of it.

a. i. Body with more or less conspicuous dark transverse bars.* About ninety scales in a longitudinal series.

S. variegata.

a. ii. Body uniformly coloured, or with indistinct pale areas, marginal fins dark. Over one hundred and twenty-five scales in a longitudinal series.

S. profundicola.

b. Snout projecting far beyond mouth, marginal fins with about every sixth fin-ray black. About seventy scales in a longitudinal series.

S. lutea.

EXPLANATION OF THE PLATES.

PLATE XXIX. *Solea vulgaris*, adult female, × $\frac{1}{5}$. The scales are sbown only on the parts used for counting the transverse rows (see page 165).

PLATE XXX. *Solea lascaris*, adult, × $\frac{5}{6}$.

PLATE XXXI. Fig. 1. *Solea vulgaris*, young, × $\frac{5}{6}$.
Fig. 2. *Solea lutea*, adult, × $\frac{5}{6}$.
Fig. 3. *Solea lutea*, blind side of bead.

PLATE XXXII. *Solea profundicola*, adult, × $\frac{5}{6}$.

PLATE XXXIII. *Solea variegata*, about half-grown, × $\frac{5}{6}$, showing full development of transverse pigment bars.

PLATE XXXIV. *Solea variegata*, large adnlt, × $\frac{5}{6}$, with transverse pigment bars almost obsolete.

* These bars remain distinguishable even in specimens which have been preserved for years in alcohol.

APPENDIX, No. VI.

THE MARINE FAUNA OF THE WEST COAST OF IRELAND.

PART III.

ECHINODERMS OF BALLYNAKILL AND BOFIN HARBOURS, CO. GALWAY, AND OF THE DEEP WATER OFF THE WEST COAST OF IRELAND.

BY

STANLEY W. KEMP, B.A.

PLATE XXXV.

I. ECHINODERMS OF BALLYNAKILL AND BOFIN HARBOURS.

Introductory.

The accompanying list is compiled from records dating back as far as 1899.

The marine laboratory was stationed in Ballynakill Harbour, but was taken over to Bofin Harbour for two summers, 1899 and 1900.

Owing to the small size of Bofin Harbour, only a few species were found in it. The list contains twenty-eight species; twenty-six species were found at Ballynakill, and sixteen at Bofin. Two species, *Holothuria nigra* and *Echinocyamus pusillus*, were found at Bofin but not at Ballynakill. These twenty-eight species constitute nearly 60 per cent. of the British Echinoderms known from less than twenty fathoms.

One species, *Astropecten irregularis*, is a deep-water form which had strayed into the harbour; only two specimens have been found.

At Ballynakill there is great variety of bottom, and the greatest depth is 12½ fathoms. Fine clean sand occurs in many places round the shore, and from it *Synapta inhaerens*, *S. digitata*, *Ophiocnida brachiata*, and *Echinocardium cordatum* may be dug at low water; Coastguard Bay especially is good ground in this respect.

Several species, such as *Asterina gibbosa*, *Echinus esculentus* and *miliaris*, and *Strongylocentrotus*, may be found by collecting among the rocks at low tides. For deeper water collecting there is a thick growth of Laminaria in the north entrance to the harbour, and Zostera beds in many places. On the mud-bottom of Freaghillaun Deep three specimens of *Ophiura* live, two of which, *O. ciliaris* and *O. albida*, occur in profusion.

From the gravelly and shelly ground in the south entrance *Antedon bifida* may often be dredged in great numbers; *Amphiura elegans* may be found in any shelly or gravelly ground, and is also common in the

Lithothamnion, which is found off the east end of Freaghillaun and on Fahy Bar. Some species, such as *Echinocardium cordatum* and *Henricia sanguinolenta*, grow to an extremely large size in Ballynakill Harbour; one particularly fine specimen of *E. cordatum*, now in the British Museum, measures 89 mm. long, 91 mm. broad, and 47 mm. high.

Asterias rubens does not, as a rule, reach its full size in the harbour, but this is by no means the case with *Ast. glacialis*, which sometimes attains to very large dimensions. One specimen measures 600 mm. across the arms.

All the localities mentioned in this paper will be found marked on the charts of Bofin and Ballynakill harbours.

As regards nomenclature, I have (except in the case of *C. elongata*) followed Bell'a Cat. Brit. Echinoderms.

HOLOTHURIOIDEA.

SYNAPTIDAE.

Synapta inhaerens (O. F. Müll.)

Ballynakill Harbour.—Sand-bank off Knocknahaw Point, Ross shore, Coastguard Bay, and Baracladdy.

Bofin Harbour.—Port Island Bay and on both sides of Port Island Passage.

Taken abundantly by digging at and near low-water mark at the above places; apparently present throughout the year.

Synapta digitata (Montagu.)

Ballynakill Harbour.—Coastguard Bay.

Bofin Harbour.—Port Island Bay.

Much less common than the preceding species. In the deep water off Coastguard Bay an enormous specimen was hauled at low tide in a tuck-net; it had very conspicuous chestnut-coloured markings.

DENDROCHIROTAE.

Cucumaria elongata (Düben and Koren.)

(Pl. XXXV., Fig. 1.)

Ballynakill Harbour.—Mouth of Derryinver Bay, 23/3/'04.

A single specimen dredged from a muddy bottom in about two fathoms.

The greatest confusion exists with regard to the synonymy of this and the allied species, and consequently a short description will possibly be useful.

The specimen is very distinctly pentangular, tapering behind. The pedicels, which are stiff and conical, form a double row in the middle of the body, while they form an alternate zigzag row at either end. There are no pedicels on the inter-ambulacra.

The body-wall is very hard and stiff, owing to the presence of large quantities of spicules. In the outer layer of the skin these take the form of minute cups with four spokes and a knobbed rim (Pl. XXXV., Fig 2); the inner layer contains numbers of large overlapping plates (Pl. XXXV., Fig. 3), usually of a rounded rectangular shape. These plates have many fine perforations; in the older ones may be seen a characteristic imperforate thickened median line running down the length of the spicule. The perforations are arranged in more or less parallel lines on each side of this thickening.

The apecimen, which is of a dull brownish plum colour, was very sluggish in its movements; it measures about 59 mm. in length, the greatest

diameter of the body being rather more than 7 mm. The tentacles, which the specimen was only seen to protrude once during a period of forty-eight hours, are very small, measuring about 3 mm. long.

This Holothurian has been previously recorded from Irish waters under the names of *C. pentactes*, Linné (?) and *C. fusiformis*, Forbes.

According to Norman *C. fusiformis*, Forbes, is a synonym for *C. elongata*, as also is *C. pentactes*, Forbes (partim).

Bell's figures of *C. pentactes*, Linné, (= *C. pentactes*, Forbes) in his catalogue of British Echinoderms, Pl. III., Fig. 1, and Pl. VIII., Fig. 2, obviously refer to some other species than *C. elongata*, or he regards the latter as a variety of the form to which he gives the name *C. pentactes*. Forbes, in his "British Star-fishes," p. 213, figures three Cucumarians under the name of *C. pentactes*, Muller; the lowermost of these, which, owing to its small tentacles, is apparently different from the other two, is probably *C. elongata*.

As there is this obscurity with regard to the true Linnean type of *pentactes*, it is evidently best to sink the name altogether, as Théel and Perrier have already done.

I am much indebted to Canon Norman for his kindness in lending me preparations of spicules of this and allied species from his collection.

Cucumaria elongata, juv. (?)

Ballynakill Harbour.—North entrance, between Freaghillaun and Lettermore, November, 1903, to March, 1904.

A number of small specimens, none more than half an inch in length, found almost without exception in the roots of Laminaria.

The specimens are pure white in colour with brown tentacles. The body-wall is stiff, owing to numbers of irregular-shaped plates with large perforations; there are also small spicules, which are of the cup type, with variable number of spokes, usually four to seven, but the rim is never complete, being separated into four portions, one portion adhering to each spoke.

Canon Norman, who has kindly examined the specimens, is of the opinion that this is probably the young of *C. elongata*.

Cucumaria Planci (Gmel.)

Cleggan Bay, off Rossadillisk, November, 1903.

Although this Holothurian has never been taken in Ballynakill Harbour, it has been thought best to mention it in this list. Cleggan Bay is so near at hand that it is almost certain that the species will before long be found in the harbour.

Thyone fusus (O. F. Müll.)

Ballynakill Harbour.—Channel and Fahy Bay.

This species has been taken several times, chiefly in the channel. Four specimens have been found in the stomach of a Scyllium.

Holothuria nigra (Bell.)

Bofin Harbour.—Eastern side of Port Island Bay; outer face of Glassillaun; outside lobster pond.

The Port Island Bay specimen was found when shore collecting; in all only three specimens have been observed.

CRINOIDEA.

ANTEDONIDAE.

Antedon bifida (Penn.)

Ballynakill Harbour.—South entrance, off Freaghillaun; Coastguard Bay, off Green Rocks, &c.

This species is abundant in the south entrance, the dredge often bringing up very large numbers. It was also found on the bottom of the hulk "Unrestricted" when beached, March, 1900; a few at the beaching of the "Saturn," March, 1902; and a very large quantity at the beaching of the "Unicorn," February, 1904. These hulks were moored in Fahy Bay.

ASTEROIDEA.

ASTROPECTINIDAE.

Astropecten irregularis (Penn.)

Ballynakill Harbour.—South entrance, March, 1904. A single specimen found in the above locality. Another example was found in Cleggan Bay off Rossadillisk, November, 1903.

These are no doubt stray specimens which had been carried in from deeper water.

ASTERINIDAE.

Asterina gibbosa (Penn.)

Ballynakill Harbour.—Roeillaun Rocks, Black Rocks, Baracladdy.

Bofin Harbour.—Glassillaun, Port Island passage; cove between lobster-pond and castle.

This species is fairly common in Bofin Harbour.

With regard to its occurrence at Ballynakill a peculiar fact is to be noted. Until March 1, 1904, this species was practically unknown in Ballynakill Harbour; on that date Mr. W. M. Tattersall took a few specimens on Roeillaun Rocks at low spring tides. A few days later it was found in enormous numbers on Black Rocks and also at Glassillaun.

These localities had been well worked previously, and it is impossible that the animal could have been overlooked. The sudden appearance of the species in such large numbers is very remarkable.

ECHINASTERIDAE.

Henricia sanguinolenta (O. F. Müll.)

Ballynakill Harbour.—Ross, Fahy Bar, Black Rocks, Roeillaun Rocks, off Freaghillaun, and in the channel.

Of frequent occurrence, often found when shore-collecting. The specimens often attain to a large size; they are usually far from typical in appearance; very few show the characteristic honey-combing on the aboral surface which this species normally presents.

Asterias glacialis (L.)

Ballynakill Harbour.—Abundant.

Bofin Harbour.—Found somewhat sparingly.

Far more plentiful at Ballynakill than at Bofin.

Asterias rubens (L.)

Ballynakill Harbour.—Abundant.

Bofin Harbour.—Abundant.

The numbers of this and the preceding species dredged together are sometimes very remarkable. On one occasion 150 *A. rubens* were taken and only a single *A. glacialis*, while on another occasion 10 *A. glacialis* were dredged and only one *A. rubens*.

OPHIUROIDEA.

OPHIOLEPIDIDAE.

Ophiura ciliaris (L.)

Ballynakill Harbour.—Abundant.

Bofin Harbour.—One record only, July, 1899.

This species is sometimes taken in great numbers in Freaghillaun deep; as many as 160 specimens have been dredged from it at one time.

Ophiura albida (Forbes.)

Ballynakill Harbour.—Abundant.

Bofin Harbour.—Abundant.

This species occurs in company with *O. ciliaris* in Freaghillaun deep on a muddy bottom. The Ballynakill specimens are, as a rule, larger than those from Bofin, and both are larger than those found in deep water.

Ophiura affinis (Lütk.)

Ballynakill Harbour.—A single specimen dredged from Freaghillaun deep, March, 1904; north of Freaghillaun, April, 1900.

Bofin Harbour.—A single specimen, July, 1899.

The specimens taken to the north of Freaghillaun were four in number and were found in a tow-net.

The "*Granuaile*" dredged a single specimen in Cleggan Bay, March, 1899. Previous Irish records of this species are from Bantry Bay and Great Skellig.

AMPHIURIDAE.

Ophiocnida brachiata (Montagu.)

Ballynakill Harbour.—Coastguard Bay, Baracladdy, and off Lettermore Quay.

In August, 1902, a complete specimen of this species was obtained by digging in Coastguard Bay. In January, 1904, a morning's digging in the same place at low spring tides resulted in the capture of twelve specimens; they were all from six to nine inches below the surface of the sand, and occurred in company with *Synapta inhaerens* and *Echinocardium cordatum*.

The Baracladdy specimen was found in March, 1904, also by digging.

The Lettermore specimen was dredged from a sandy bottom, March, 1904. In March, 1899, the "*Granuaile*" dredged up fragments of the arms of an *Ophiuroid*, which are certainly to be referred to this species. They were taken "in the otter-trawl on the trawling ground off and in the mouth of Cleggan Bay." This and the Lettermore record are somewhat

remarkable, as the dredging was carried on in deep water and never approached low-water mark. The speed with which this *Ophiuroid* buries itself in the sand is remarkable. If a specimen is placed in a pan of sea-water with fine sand at the bottom, it will in most cases completely disappear from sight in three minutes time. It accomplishes this by active movements of the podia and not by flexions of the arms.

O. brachiata must be very local, and is probably associated with a particular quality of sand; the *Synapta* ground at Bofin has been well dug, and none have ever been found there. In Coastguard Bay it occurs below the surface of the bare sand, and also intertwined among the roots of Zostera.

This interesting species has only once previously been recorded from the west coast, *i.e.*, Kenmare River, 1892.

Amphiura filiformis (O. F. Müll.)

Ballynakill Harbour.—South entrance, March, 1899.

Bofin Harbour.—August, 1899.

Not common.

Amphiura elegans (Leach.)

Ballynakill Harbour.—Abundant.

Bofin Harbour.—A single record, June, 1899.

This species is very common at Ballynakill on gravelly, shelly, or Lithothamnion bottom.

OPHIOCOMIDAE.

Ophiocoma nigra (Abilg.)

Ballynakill Harbour.—Off Coastguard Bay.

This Ophiuroid occurs at Ballynakill only in a single spot of very restricted area on a bottom consisting of coarse gravel and shells; if dredging exactly on this spot the species may be taken in some numbers. The specimens taken are always quite black, never yellowish or mottled.

OPHIOTHRICIDAE.

Ophiothrix fragilis (Abilg.)

Ballynakill Harbour.—Common.

Bofin Harbour.—Common.

Generally abundant both at Ballynakill and Bofin, usually on a gravelly or shelly bottom.

ECHINOIDEA.

ECHINIDAE.

Echinus miliaris (Gmel.)

Ballynakill Harbour.—Black Rocks; Roeillaun; North entrance; off Freaghillaun, &c.

Bofin Harbour.—Cove between lobster-pond and castle.

Of frequent occurrence at Ballynakill; usually found when shore-collecting.

Echinus esculentus (L.)

Ballynakill Harbour.—Baracladdy, Glassillaun Rocks, and Lecknascona. Commonly found when shore-collecting at the above localities.

Strongylocentrotus lividus (Lamk.)

Ballynakill Harbour.—Ross shore, Garaun Boulder, Black Rocks, Freaghillaun, &c.

Bofin Harbour.—Port Island Passage.

Commonly found when shore-collecting, and also by dredging on Lithothamnion ground at Ballynakill. Common at Bofin in rock-pools on the seaward face of Port Island.

CLYPEASTRIDAE.

Echinocyamus pusillus (O. F. Müll.)

Bofin Harbour.—A single specimen dredged off the mouth of the harbour, September, 1899.

This Echinoid has never been taken in Ballynakill Harbour. At Bofin it has also been taken off the north end of the White Strand, June, 1899; and between Bofin and Davillaun, September, 1899.

SPATANGIDAE.

Spatangus purpureus (O. F. Müll.)

Ballynakill Harbour.—Ardkyle shore, March, 1900; Black Rocks, March, 1904.

Only these two records; the species has never been found in Bofin, but fragments have been dredged outside the harbour.

Echinocardium cordatum (Penn.)

Ballynakill Harbour.—Abundant.

Bofin Harbour.—Abundant.

Occurs wherever there is fine sand in which to bury itself. The species grows to an enormous size both at Bofin and Ballynakill.

E. flavescens has never been taken at Bofin or Ballynakill, but in August, 1889, two specimens were dredged between Bofin and Davillaun.

II. ECHINODERMS OF THE DEEP WATER OFF THE WEST COAST OF IRELAND.

Introductory.

The accompanying list contains all the species of Echinoderm—seventy-three in number—that have been found off the west coast of Ireland outside the 50-fathom line.

Between the years 1869 and 1895 nine expeditions were made to investigate the west coast fauna, organised for the most part by the Royal Irish Academy and Royal Dublin Society.

The following is a list of these expeditions, with dates, and the authorities who named the Echinoderms collected.

"Porcupine" Expedition,	1869	Wyville Thomson, Percy Sladen, W. E. Hoyle, A. Agassiz.
"Lord Bandon" 1st Expedition,	1885	F. Jeffrey Bell and A. C. Haddon.
"Lord Bandon" 2nd Expedition,	1886	A. C. Haddon.
"Flying Falcon" Expedition,	1888	Percy Sladen.
"Flying Fox" Expedition,	1889	F. Jeffrey Bell.
"Fingal" Expedition,	1890	F. Jeffrey Bell.
"Research" Expedition,	1890	F. Jeffrey Bell.
"Harlequin" Expedition,	1891	F. Jeffrey Bell.
"Granuaile" Rockall Expedition,	1895	Percy Sladen.

Since 1900 the *Helga* has continued the work and added a large number of records to those previously known. Of these the most important are *Laetmogone violacea*, *Plutonaster Pareli*, *Solaster affinis*, *Ophiura signata*, *Ophiacantha abyssicola*, *Phormosoma placenta*, *Echinus tenuispinus*, and *Echinocardium pennatifidum*.

Two specimens of *Laetmogone violacea* were taken from 382 fathoms off Achill Head, Co. Mayo.

A single *Plutonaster Pareli*, taken from 220 fathoms off the north of Mayo, brings this species within the British area as defined by Canon Norman. A previous record from 1,360 fathoms was made by the *Porcupine*.

Solaster affinis is a species created by Danielssen and Koren for specimens taken by the Danish Ingolf Expedition. Prof. Jeffrey Bell considers that three specimens from the west coast, which are very similar in appearance to *S. papposus*, but with only ten or eleven rays, may safely be referred to this species.

Of *Ophiura signata* only a single specimen has previously been recorded from Irish waters. It was taken by the *Flying Falcon*, and Sladen remarks that it differs very considerably from typical *O. signata*. A large number of specimens, unfortunately mostly broken, have been dredged by the *Helga* in 129–327 fathoms. These examples show very little variation among each other and are somewhat intermediate in character between the *Flying Falcon* specimen and the typical form. There can be no doubt that this is a special race of *O. signata* inhabiting Irish waters, but on account of the small extent of our knowledge of these animals, I do not feel justified in giving the form a varietal name.

Ophiacantha abyssicola is a species new to Irish waters; it was taken from 388 f., in company with *Ophiactis Balli*.

Echinus tenuispinus is a species recently described by Mortensen from two specimens found by the *Helga* on the Porcupine Bank. The species is

closely allied to *Echinus esculentus*, but is white in colour and inhabits deep water. Three other specimens have been taken by the *Helga*.

The *Helga* has also increased our knowledge of the bathymetric range of several species; a form of *Synapta digitata* was found in 112 fathoms, *Luidia ciliaris* occurred in 120 fathoms, and a small specimen of *Porania pulvillus* was taken in 388 fathoms, an increase in depth of more than 280 fathoms.

In the list which follows the exact localities and depths have been given wherever possible; the latitude and longitude of the various stations will be found in the tables at the end.

Although outside the Irish marine boundary, I have included in the form of an appendix a list of the Echinoderms of the Rockall Bank and neighbouring waters. The chief expedition to investigate the fauna of this Bank was conducted in the *Granuaile* in 1895, under the auspices of the Royal Irish Academy.

My thanks are due to Prof. Bell and to the Rev. Canon Norman for their kindness and valuable help. As regards nomenclature, I have followed Bell's Catalogue of Brit. Echinoderms, except in the case of Echinus, where I have included *E. norvegicus* and *E. microstoma* as varieties of *E. acutus*, as Mortensen does in his recent work on the Danish Ingolf Echinoidea.

N.B.—All bearings are magnetic.

HOLOTHURIOIDEA.

SYNAPTIDAE.

Synapta inhaerens (O. F. Müll.)

6 miles W. of Inishmore, Aran Islands. 50 f.
(probably *S. inhaerens*). . . . . . *Harlequin.*

This species is rarely found in more than 30 fathoms. Mr. W. I. Beaumont dredged a specimen from 45 f. off Bray Head, Valencia, and another was taken by the *Porcupine* Exp. in 96 f., 49° 7′ N., 10° 57′ W. This locality is outside the southern boundary of the British marine area.

Synapta digitata (Montagu.)
var. profundicola (var. nov.)

50 miles W.N.W. of Slyne Head, Co. Galway.
112 f. One spec. . . . . *Helga.*

According to Prof. Bell, this species has not hitherto been found in more than 20 fathoms of water; when therefore during August, 1904, the *Helga* trawled a small purple *Synapta* from 112 fathoms, I thought it would prove some other species than the *S. inhaerens* and *digitata*, which occur in shallow water all along the west coast.*

On examination, however, the specimen was found to be undoubtedly *S. digitata*, although it presented many minor differences, which are, I think, sufficient to entitle it to a varietal name. I therefore propose to call it var. *profundicola*, on account of the depth at which it was found.

The anchor-plates are formed on the same plan as in typical *digitata*, but are far more irregular and of a lighter build. They are roughly triangular in shape, with six large primary holes, three at the base near the handle, two larger ones in the middle, and a single one at the apex. In

* Since the above went to press Canon Norman has written to tell me that in 1861 he took a purple *Synapta digitata* off the Shetland Isles in 40 fathoms.—(v. *Rep. Brit. Ass.*, 1868, p. 318.)

the shoulders of the plate there are usually about eight small perforations, crowded together and irregular in shape. The primary perforations are often completely or incompletely divided by a narrow bar. The handle of the anchor-plate has usually abont four perforations, one or more of which are very elongated. All the perforations have smooth edges.

The anchors are longer than in typical *digitata*, the shank being, as a rule, twice as long as the breadth across the flukes, and often longer. The flukes form an angle of 45° with the shank; sometimes their outer edge is smooth and sometimes it is very strongly serrated.

In other respects, such as the possession of twelve tentacles with five digits, a single madreporic canal and Polian vesicle, and oval miliary granules, which are often constricted in the middle, the specimen is identical with *S. digitata*.

As regards colonr, it is a deep pnrple (littoral *digitata* are usually brown or banded with brown), and a month in spirit has had no effect upon it. The tentacles are white with slightly purplish bases. The specimen measures about 32 mm. in length.

DENDROCHIROTAE.

Cucumaria Hyndmani (Thompson.)

115 miles N.W. by W. ¾ W. of Skelligs, Co. Kerry. 251 f. Three specs. . . . . . *Porcupine.*
56 miles off Dursey Head, Co. Kerry. 345 f. One juv. . . . . *Flying Falcon.*

Cucumaria hispida (Barrett.)

39 miles W.N.W. of Black Rock, Blacksod Bay. 422 f. . . . . *Porcupine.*
135 miles W. by S. ½ S. of Fastnet, off C. Clear. 1,207 f. . . . . *Porcupine.*

The only Irish records.

Thyone raphanus (Düb. and Kor.)

12 miles S.W. of Great Skellig, Co. Kerry. 70 f. *Lord Bandon* (1).

Psolus Fabricii (Düb. and Kor.)?

31 miles N.N.W. wly. of Eagle Island, N. Mayo. 350 f. Three specs. . . . . . *Helga.*
50 miles W.N.W. of Eagle Island, N. Mayo. 388 f. Fourteen small specs. . . . *Helga.*

The three specimens from 350 fathoms are considerably larger than those taken by the *Harlequin* in 1901, and have the following measurements:—

Length, . . .	47 mm.	45 mm.	42 mm.
Width, . . .	32 mm.	38 mm.	30 mm.
Height, . . .	12 mm.	9 mm.	10 mm.

Although these specimens are by no means mature, I have very little doubt that they are referable to *P. Fabricii*, and therefore record them as such provisionally.

There are a few podia at the anterior and posterior ends of the median line, bnt none in the middle. The sole is strengthened with calcareous deposits in the form of small irregular plates, which althongh by no means fully formed, show in many cases the knobs which Prof. Bell figures (Cat. Brit. Echin., Pl. vi., fig. 3) as characteristic of *P. Fabricii*.

Psolus sp. juv.

45 miles N.N.W. of Achill Head, Co. Mayo.
500 f. Three specs. . . . . . . *Harlequin.*

The specimens are in the National Museum, Dublin; owing to their immature condition Prof. Bell was unable to give them a specific name.

Phyllophorus pellucidus (Düb and Kor.)

(Locality lost). 50 f. . . . . *Flying Falcon.*

ASPIDOCHIROTAE.

Holothuria intestinalis (Asc. and Rathke.)

56 miles off Dursey Head, Co. Kerry. 345 f. . *Flying Falcon.*
86 miles W. by N. of Fastnet, off C. Clear. 750 f. *Flying Falcon.*
40 miles N.W. ¼ N. of Achill Head, Co. Mayo.
220 f. One spec. . . . . *Fingal.*
20 miles N. by W. of Eagle Island, N. Mayo.
70 f. One spec. . . . . *Helga.*
75 miles S.W. by W. ½ W. of Fastnet, off C. Clear.
190 f. . . . . *Helga.*

Not common; single examples usually found. The *Flying Falcon* Fastnet record increased the bathymetric range of this species from 672 to 750 fathoms.

Holothuria tremula (Gunnerus.)

Common.—Abundant records ranging from 45 miles N.N.W. of Achill Head, Co. Mayo, to 77 miles W.S.W. of Fastnet, off C. Clear, and from 70–500 fathoms.

Taken by the *Porcupine* Exp. off Rockall Bank in 1,476 f. (v. *infra*). This is an increase of over 800 f. on any other record.

Holothuria aspera (Bell.)

W. by S. of Fastnet. 1,000 f. . . . . . *Flying Fox.*
A unique specimen. For description, *v.* Bell, Ann. and Mag., IV., (1889), p. 445.

[**Stichopus natans** (Sars.)]

84 miles W. by N. of Fastnet, off C. Clear. 750 f. *Flying Falcon.*

This is the only British record. Prof. Bell in his Cat. Brit. Echin., p. 51, says: "So far as I can form a judgment from the specimen, I am inclined to doubt very strongly its being an example of *S. natans.*"

DEIMATIDAE.

Laetmogone violacea (Théel.)

84 miles W. by N. of Fastnet, off C. Clear. 750 f. *Flying Falcon.*
77 miles W.N.W. of Achill Head, Co. Mayo. 382 f. *Helga.*

According to a note in the log-book the colour of this rare species when alive is "pale, semi-translucent, and purplish, with oval processes yellow at extremities." *L. violacea* was taken by the *Challenger* in 555 and 950 fathoms in the Faeroe Channel and off Sydney.

CRINOIDEA.

BOURGUETICRINIDAE.

[Rhizocrinus lofotensis (Sars.)?]

64 miles N.W. ½ W. of Cleggan Head, Co. Galway. 199 f. . . . . *Helga.*

A small Crinoid from the above locality was referred to *Rhizocrinus.* Unfortunately the specimen was mislaid before a critical examination had been made. The species is in all probability *R. lofotensis.*

ANTEDONIDAE.

Antedon bifida (Penn.)

5–8 miles W. of Great Skellig, Co. Kerry. 70–80 f. One spec. . . . . *Lord Bandon* (2).
About 45–60 miles W. ½ N. of Dursey Head, Co. Kerry. 250 f. Two specs. . . . . . *Flying Fox.*
3–5 miles S.W. by S. of Great Skellig, Co. Kerry. 60 f. One spec. . . . . *Helga.*

Rarely found in over 50 fathoms of water. The *Flying Fox* record is the only certain occasion on which this species has been taken in more than 100 fathoms.

Antedon, sp.?

77 miles W.N.W. of Achill Head, Co. Mayo. 382 f. Two specs. . . . . . . *Helga.*

One of these specimens, with all the arms broken off and only a portion of a cirrus remaining, is certainly not *A. bifida,* the cirrus joints being long and slender. The other specimen is small and bears a somewhat close resemblance to *A. bifida,* but owing to the depth at which it was taken, I hesitate to record it as that species.

Antedon phalangium (J. Müll.)

About 45–60 miles W. ½ N. of Dursey Head, Co. Kerry. 250 f. . . . . *Flying Fox.*

ASTEROIDEA.

ARCHASTERIDAE.

Pontaster tenuispinis (Düb. and Kor.)

About 55 miles N.W. ¼ N. of Valentia, Co. Kerry. 90–159 f. Two specs. (*sub P. tenuispinis var. platynota* and *P. limbatus.* Sladen, *Chall. Rep. Ast.*). . . . . . . *Porcupine.*
50 miles W. ½ S. of Dursey Head, Co. Kerry. 214 f. . . . . *Lord Bandon* (2).
53 miles W. ½ S. of Dursey Head, Co. Kerry. 325 f. Ninety-two specs. . . . . *Lord Bandon* (2).
56 miles off Dursey Head, Co. Kerry. 345 f. (*sub P. limbatus,* Sladen). . . . . *Flying Falcon.*

About 45–60 miles W. $\frac{1}{2}$ N. of Dursey Head, Co. Kerry. 250 f.	*Flying Fox.*
71 miles W. by S. of Fastnet, off C. Clear. 315 f.	*Flying Fox.*
77 miles W.S.W. of Fastnet, off C. Clear. 400 f.	*Research.*
75 miles S.W. by W. $\frac{1}{2}$ W. of Fastnet, off C. Clear. 100 f.	*Helga.*
50 miles W.N.W. of Tearaght Lighthouse, Co. Kerry. 396$\frac{1}{2}$ f. Three specs.	*Helga.*
50 miles W.N.W. Nly. of Tearaght Light, Co. Kerry. 375 f. Many.	*Helga.*
48 miles N.W. by W. $\frac{3}{4}$ W. of Tearaght Light, Co. Kerry. 337 f. Twenty-five specs.	*Helga.*

Plutonaster bifrons (Wyv. Thoms.)

46 miles N. by W. $\frac{1}{2}$ W. of Eagle Island, N. Mayo. 1,360 f.	*Porcupine.*
86 miles W. by N. of Fastnet, off C. Clear. 750 f.	*Flying Falcon.*

Plutonaster Pareli (Düb. and Kor.)

46 miles N. by W. $\frac{1}{2}$ W. of Eagle Island, N. Mayo. 1,360 f.	*Porcupine.*
81 miles W. $\frac{1}{2}$ N. of Eagle Island, N. Mayo. 220 f. One spec.	*Helga.*

Very rare.

ASTROPECTINIDAE.

Astropecten irregularis (Penn.)

Of common occurrence both inside and outside the 50 fathom line, up to 1,000 f. (*Flying Fox*). One particularly large specimen dredged in 120 f. off Cleggan Head, Co. Galway (*Helga*), has the following measurements:—R=97 mm. r=21 mm.

Astropecten sphenoplax (Bell.)

45 miles N.N.W. of Achill Head, Co. Mayo. 500 f. Seven specs.	*Harlequin.*

Although thirteen years have elapsed since Prof. Bell described this species, it has not again been found. I am unable to recognise it among any of the recently taken Astropecten from the west coast.

For description *v.* Bell, Echinoderms Coll. by S.S. *Fingal*, Sci. Proc. R.D.S., 1892, p. 522.

Psilaster andromeda (M. and Tr.)

(Locality lost).	*Flying Falcon.*
45 miles N.N.W. of Achill Head, Co. Mayo. 500 f.	*Harlequin.*
77 miles W.S.W. of Fastnet, off C. Clear. 400 f.	*Research.*
50 miles W.N.W. of Tearaght Light, Co. Kerry. 396$\frac{1}{2}$ f. One spec.	*Helga.*
50 miles W.N.W. Nly. of Tearaght Light, Co. Kerry. 375 f. One spec.	*Helga.*
48 miles N.W. by W. $\frac{3}{4}$ W. of Tearaght Light, Co. Kerry. 337 f. One spec.	*Helga.*
54 miles W. by N. $\frac{1}{2}$ N. Nly. of Tearaght Light, Co. Kerry. 454 f. Two specs.	*Helga.*

Luidia ciliaris (Philippi.)

(Locality lost). 52 f.	*Flying Falcon.*
South of Galley Head, Co. Cork. 55 f. Two specs.	*Flying Fox.*
14 miles W. by N. ½ N. of Bolus Head, Co. Kerry. 80 f.	*Fingal.*
60 miles S.W. ½ S. of Fastnet, off C. Clear. 70 f.	*Research.*
7 miles S. by W. of Tearaght Light, Co. Kerry. 53 f. One spec.	*Helga.*
50 miles W.N.W. of Cleggan Head, Co. Galway. 120 f. One spec.	*Helga.*

Probably more abundant than these records show. The specimen from 50 miles off Cleggan Head increases the bathymetric range of the species from 87 to 120 fathoms.

Luidia Sarsi (Düb. and Kor.)

48 miles N.W. by W. ¾ W. of Tearaght Light, Co. Kerry. 337 f. Small, abundant.	*Helga.*
39 miles W.N.W. Nly. of Tearaght Light, Co. Kerry, 244½ f. Seventeen specs.	*Helga.*

Generally distributed, inside the 50-fathom line and down to 130 fathoms.

PENTAGONASTERIDAE.

Pentagonaster granularis (Retz.)

86 m. W. by N. of Fastnet, off C. Clear. 750 f. Two specs. (Sladen *sub P. balteatus* and *P. concinnus*).	*Flying Falcon.*
50 miles W.N.W. of Eagle Island, N. Mayo. 388 f. One small spec.	*Helga.*

Pentagonaster Greeni (Bell.)

W. by S. of Fastnet, off Cape Clear. 1,000 f.	*Flying Fox.*

The only specimen known. For description, *v.* Bell, Ann. and Mag. iv. (1889), p. 433.

Nymphaster subspinosus (Perrier.)

(Locality lost). *sub. N. protentus.*	*Flying Falcon.*
71 miles W. by S. of Fastnet, off Cape Clear. 315 f. Five specs. *sub N. protentus.*	*Flying Fox.*
77 miles W.S.W. of Fastnet, off C. Clear. 400 f. Three specs.	*Research.*
75 miles S. W. by W. ½ W. of Fastnet, off C. Clear. 190 f. One spec.	*Helga.*

One of the *Flying Fox* specimens has only four rays.

GYMNASTERIIDAE.

Porania pulvillus (O. F. Müll.)

71 miles W. by S. ¼ S. of Achill Head, Co. Mayo. 106 f.	*Porcupine.*
5–8 miles W. of Great Skellig, Co. Kerry. 70–80 f.	*Lord Bandon* (2).
60 miles S.W. ½ S. of Fastnet, off C. Clear. 70 f.	*Research.*

40 miles W. N. W. of Cleggan Head, Co. Galway.
70–78 f. Four specs. . . . . . . *Helga.*
27 miles W. by N. ¼ N. of Bray Head, Valencia.
100 f. Three specs. . . . . . *Helga.*
50 miles W.N.W. of Eagle Island, N. Mayo.
388 f. One small spec. . . . . . *Helga.*
32 miles W. ¼ S. of Tearaght Light, Co. Kerry.
129 f. One spec. . . . . *Helga.*

The Eagle Island record increases the bathymetric range of this species from 106 to 388 fathoms.

Cheilaster fimbriatus (Sladen.)

46 miles N. by W. ½ W. of Eagle Island, Co. Mayo. 1,360 f. One spec. . . . . . *Porcupine.*

The only specimen known.

ASTERINIDAE.

Palmipes placenta (Penn.)

60 miles and 62 miles S.W. ½ S. of Fastnet, off C. Clear. 70 f. . . . . *Research.*
3–5 miles S.W. by S. of Great Skellig, Co. Kerry. 60–65 f. One spec. . . . . *Helga.*
6½ miles W. by S. of Skelligs Light, Co. Kerry. 72 f. Two specs. . . . . . . *Helga.*
40 miles W. by S. of Cleggan Head, Co. Galway. 76 f. One spec. . . . . . . *Helga.*
40 miles W.N.W. of Cleggan Head, Co. Galway. 70–78 f. One small spec. Diam. = 12 mm. . *Helga.*
112 miles N.W. by W. ¾ W. of Slyne Head, Co. Galway. 135 f. Two specs. . . . . *Helga.*

STICHASTERIDAE.

Stichaster roseus (O. F. Müll.)

(Localities lost). 50 and 54 f. . . . . . *Flying Falcon.*
30 miles W. ¼ N. of Achill Head, Co. Mayo. 144 f. . . . . *Fingal.*
67 miles W. ½ S. of Fastnet, off C. Clear. 200 f. *Research.*
40 miles N.W. by N. of Cleggan Head, Co. Galway. 105 f. One spec. . . . . . *Helga.*
50 miles N.W. by N. of Cleggan Head, Co. Galway. 120 f. One spec. . . . . . *Helga.*
50 miles W.N.W. of Cleggan Head, Co. Galway. 120 f. One spec. . . . . . *Helga.*
32 miles W. ¼ S. of Tearaght Light, Co. Kerry. 129 f. Three specs. . . . . . *Helga.*
39 miles W.N.W. Nly. of Tearaght Light, Co. Kerry. 244½ f. Two specs. . . . *Helga.*

Neomorphaster eustichus (Sladen.)

86 miles W. by N. of Fastnet, off C. Clear. 750 f. One spec. . . . . *Flying Falcon.*

The only other known locality in which this species has been taken is off the Azores, 900-1,000 fathoms (*Challenger*).

Zoroaster fulgens (Wyv. Thoms.)

86 miles W. by N. of Fastnet, off C. Clear. 750 f. *Flying Falcon.*

SOLASTERIDAE.

Solaster affinis (Danielssen and Koren.)

5-8 miles W. of Great Skellig, Co. Kerry. 70-80 f.
One spec. 11-armed, *sub S. papposus* (Haddon), *Proc. R.I.A.* (3), 1888, i., pp. 31-45. . . *Lord Bandon* (2).
40 miles W. N. W. of Cleggan Head, Co. Galway.
70 f. One spec. 10-armed. . . . . . *Helga.*

S. affinis was described by Danielssen and Koren from specimens dredged during the Norwegian North Sea Expedition. Examples from this expedition are in the British Museum, and Prof. Bell has compared them with the ten and eleven-armed Solasters from the west coast of Ireland, and finds they resemble one another very closely. He has consequently named the species provisionally as *S. affinis*.

Two other specimens, with ten and eleven arms respectively, have been dredged by the *Helga* in 25 fathoms, about 2 miles N. of Clare Island, off the Galway coast.

It is to be noted that although the bathymetric ranges of *S. papposus* and *S. endeca* extend to 640 f. and 150 f. respectively, neither species has been taken on the west coast outside the 50-fathom line.

PTERASTERIDAE.

Pteraster personatus (Sladen.)

84 miles W. by N. of Fastnet, off C. Clear. 750 f.
One spec. . . . . *Flying Falcon.*

The only specimen ever found.

Hymenaster giganteus (Sladen.)

84 miles W. by N. of Fastnet, off C. Clear.
750 f. One spec. . . . . *Flying Falcon.*

The type specimen.

ECHINASTERIDAE.

Henricia sanguinolenta (O. F. Müll.)

84 miles W. by N. of Fastnet, off C. Clear. 750 f.
var. *abyssicola.* . . . . . . *Flying Falcon.*
South of Galley Head, Co. Cork. 55 f. . . *Flying Fox.*

The bathymetric range of this species is littoral to 1,350 fathoms.

ASTERIIDAE.

[Asterias glacialis (L.)]

Found by the *Research* in 90 fathoms, below the southern boundary of the British area.

Asterias rubens (L.)

43 miles W. ¾ S. of Dursey Head, Co. Kerry. 110 f. One spec.	*Lord Bandon* (2).
37 miles W. of Bull Rock, Co. Kerry. 100 f.	*Flying Fox.*
67 miles W. ¼ S. of Fastnet, off C. Clear. 200 f.	*Research.*
27 miles W. by N. ¼ N. of Bray Head, Valentia. 100 f. Two specs.	*Helga.*
32 miles W. ¼ S. of Tearaght Light, Co. Kerry. 129 f. One spec.	*Helga.*

Also taken in many localities between 50 and 100 fathoms.
200 fathoms is the greatest depth from which this starfish is known.

Asterias Murrayi (Bell.)

40 miles W. of Bolus Head, Co. Kerry. 115 f.	*Harlequin.*

BRISINGIDAE.

Brisinga endecacnemos (Asbj.)

About 55 miles N.W. ½ N. of Valentia, Co. Kerry. 90–159 f.	*Porcupine.*
62 miles W. of C. Clear. 458 f.	*Porcupine.*
53 miles W. ½ S. of Dursey Head, Co. Kerry. 325 f. Ten specs.	*Lord Bandon* (2).
48 miles N.W. by W. ¾ W. of Tearaght Light, Co. Kerry. 337 f. 12 discs, many arms.	*Helga.*

Brisinga coronata (G. O. Sars.)

72 miles W. ¼ N. of C. Clear. 458 f.	*Porcupine.*
56 miles off Dursey Head, Co. Kerry. 345 f.	*Flying Falcon.*
W. by S. of Fastnet, off C. Clear. 1,000 f. One injured spec.	*Research.*
108 miles S.W. ½ W. of Fastnet, off C. Clear. 200 f. Fragments.	*Flying Fox.*

Brisinga sp.

50 miles W.N.W. of Tearaght Lighthouse, Co. Kerry. 396½ f. Fragments.	*Helga.*

OPHIUROIDEA.

OPHIOLEPIDIDAE.

Ophiura ciliaris (L.)

About 62 miles W. ¾ N. of C. Clear. 180 f.	*Porcupine.*
50 miles W.N.W. of Cleggan Head, Co. Galway. 120 f.	*Helga.*
64 miles N.W. ½ W. of Cleggan Head, Co. Galway. 199 f.	*Helga.*

Also many records between 50 and 100 fathoms.
This species reaches a very large size off the west coast; a specimen taken on the first expedition of the *Lord Bandon* measured 33 mm. across the disc.

Ophiura albida (Forbes.)

35 miles N.W. by N. of Achill Head, Co. Mayo. 175 f. . . . . *Fingal.*
20 miles W.N.W. of Cleggan Head, Co. Galway. 65 f. One spec. . . . . *Helga.*
40 miles W.N.W. of Cleggan Head, Co. Galway. 70—78 f. Three specs. . . . . . *Helga.*
50 miles W.N.W. of Cleggan Head, Co. Galway. 120 f. Several. . . . . . . *Helga.*
64 miles N.W. ½ W. of Cleggan Head, Co. Galway. 199 f. Many. . . . . *Helga.*

This species never seems to attain its full size in deep water.

Ophiura Sarsi (Lütk.)

94 miles S. ¾ E. of Fastnet, off C. Clear. 75 f. A young spec. . . . . *Porcupine.*

This specimen was named by Mr. W. E. Hoyle, who is rather doubtful of the determination. As the species has been taken on the Rockall Bank, there seems no reason why it should not occur further south.

Ophiura signata (Verrill.)

Pl. XXXV. Figs. 4-7.

56 miles off Dursey Head, Co. Kerry. 345 f. A young spec. . . . . *Flying Falcon.*
50 miles W.N.W. of Cleggan Head, Co. Galway. 129 f. One spec. . . . . *Helga.*
64 miles N.W. ½ W. of Cleggan Head, Co. Galway. 199 f. Several. . . . . *Helga.*
50 miles W.N.W. of Tearaght Light, Co. Kerry. 327 f. Many broken. . . . . . *Helga.*
81 miles W. ½ N. of Eagle Island, N. Mayo. 220 f. Several. . . . . *Helga.*
54 miles W. by N. ½ N. Wly. of Tearaght Light, Co. Kerry. 454 f. v. abundant. . . . *Helga.*

This species was first recorded as British in 1880 (*Knight Errant* Exp.), when it was dredged in the cold area of the Faeroe Channel. In 1882, also in the Faeroe Channel, Mr. W. E. Hoyle dredged a large number of specimens from the cold area and three from the warm area.

With reference to the *Flying Falcon* specimen, Mr. Sladen says:—"A young example, which approaches very closely indeed in character to *Ophioglypha affinis*, Lütk. The form of the mouth-shields in this specimen resembles that of *O. affinis* much more closely than that of the figure given by Mr. W. E. Hoyle of *O. signata*; and the uppermost arm spine is not so long as described by Verrill, it being scarcely longer than the middle one."

All the specimens taken by the *Helga* agree exactly with these remarks; the angle of the mouth-shields on their inner edge is slightly acute, never obtuse, as figured by Mr. Hoyle (*Proc. Roy. Soc., Edin.*, vol. xii., pl. vii., fig. 6).

I have examined the *Flying Falcon* specimen, and also an example kindly lent me by the Rev. Canon Norman, with the result that I am able to figure four definite forms of mouth-shield in this species.

In Canon Norman's specimen the mouth-shield is slightly wider than long with obtuse inner angle, Pl. XXXV., Fig. 7; in Mr. Hoyle's figure the mouth-shield is about as broad as long, with inner angle not quite so obtuse as in the last, and it is moreover widest across its inner half, Pl. XXXV., Fig 4. In the specimens dredged by the *Helga*, the mouth-shield is slightly longer than broad, with somewhat acute inner angle,

Pl. XXXV., Fig 6. The *Flying Falcon* specimen has an evidently rounded mouth-shield, with acute rounded inner angle, and it is widest across the middle, Pl. XXXV., Fig. 5.

I have no doubt that if a sufficient number of specimens from different localities were compared, it would be possible to connect all these forms with intermediate ones.

In any case, in spite of its variation, the mouth-shield is quite sufficient to form a good distinction between *O. signata* and *O. affinis* (the only other species which has the primary disc-scales surrounded by rosettes of small scales), for in *O. signata* it is never very much longer than broad, whereas in *O. affinis* it is always quite twice as long as broad.

In addition to this the species may easily be separated by means of the spines on the arm-comb. At first sight *O. signata* does not seem to possess any comb-spines at all, for they are somewhat hidden by the overlapping margin of the disc; on close examination a series of minute spinules are seen on either side of the notch, and a small group on the first visible arm-plate. *O. affinis* has always about ten small but definite spines, which are easily visible without any special examination.

The bathymetric range of *O. signata*, according to Prof. Bell, is 327-640 f. The specimen from 50 miles off Cleggan Head was taken in 129 fathoms, and the range of the species is therefore increased by nearly 200 fathoms.

Special reference should be made to the 454 fathom record. On this occasion the townets attached to the trawl came up full of a fine mud, composed chiefly of foraminifera; this mud was passed through a sieve and great numbers of large and perfect *O. signata* were thus found.

Ophiura affinis (Lütk.)

25 miles W.N.W. of Great Skellig, Co. Kerry. 110--120 f. . . . . *Lord Bandon* (1).
20 miles W.N.W. of Cleggan Head, Co. Galway. 65 f. Many. . . . . *Helga.*
50 miles W.N.W. of Cleggan Head, Co. Galway. 120 f. One small. . . . . . . *Helga.*
40 miles W.N.W. of Cleggan Head, Co. Galway. $74\frac{1}{2}$ f. One broken spec. . . . . *Helga.*

Ophiocten sericeum (Forbes.)

77 miles W.S.W. of Fastnet, off C. Clear. 400 f. *Research.*

[Ophiochiton ternispinis (Lyman.)]

Prof. Bell includes this species in his list of British Echinoderms on the strength of a single specimen taken at St. 42, S.W. Ireland, 862 f., *Porcupine.* St. 42 is 120 miles W.S.W. of Fastnet, off C. Clear, lat. 49° 12′ N., long. 12° 52′ W., and is considerably below the southern limit of the British area (49° 30′ N.). Until this species is found further north it cannot justly be included in the Irish deep sea fauna.

AMPHIURIDAE.

Ophiomusium Lymani (Thoms.)

About 62 miles W. ¾ N. of C. Clear. 180 f. . *Porcupine.*

Prof. Bell gives 50° 1′ N., 10° 2′ W. as the lat. and long. of this station; the depth at this locality however is certainly not more than 75 fathoms by chart. Wyville Thomson, in "The Depths of the Sea," mentions that *Ophiomusium* was taken at St. 45a. in 180 fathoms, but gives no lat. and long. I would suggest that 51° 1′ N., 11° 2′ W. is more likely to be correct; possibly a misprint in Prof. Bell's catalogue accounts for the mistake. This is the only known locality in the British area for this Ophiuroid; the specimen has unfortunately been lost.

Amphiura Chiajii (Forbes.)

94 S. ¾ E. of Fastnet, off C. Clear. 75 f. . *Porcupine.*

Amphiura filiformis (O. F. Müll.)

12 miles S.W. of Great Skellig, Co. Kerry. 75 f. *Lord Bandon* (1).
7 miles S. by W. of Tearaght Light, Co. Kerry. 53 f. Four specs. . . . . . *Helga.*
50 miles W.N.W. of Cleggan Head, Co Galway. 116 f. One broken spec. . . . . . . *Helga.*

Of common occurrence inside the 50-fathom line.

Amphiura elegans (Leach.)

38 miles W. ½ S. of Dursey Head, Co. Kerry. 108 f. . . . . *Lord Bandon* (2).
60 miles S.W. ½ S. of Fastnet, off C. Clear. 70 f. Two specs. . . . . *Research.*

Common in shallow water.

Ophiactis Balli (Thompson.)

35 miles W. ½ N. of Fastnet, off C. Clear. 80 f. *Lord Bandon* (1).
20 miles W.N.W. of Cleggan Head, Co. Galway. 65 f. Many. . . . . *Helga.*
3·5 miles S.W. by S. of Great Skellig, Co. Kerry. 60-65 f. In crevices of stones. . . . *Helga.*
40 miles W.N.W. of Cleggan Head, Co. Galway. 78 f. Many. . . . . *Helga.*
50 miles W.N.W. of Eagle Island, N. Mayo. 388 f. Many. . . . . *Helga.*

This species is nearly always found tucked away in crevices of limestone boulders.

Ophiopholis aculeata (Linn.)

Abundant between 50 and 100 fathoms. Has been found on the Porcupine Bank.

Ophiacantha abyssicola (G. O. Sars.)

50 miles W.N.W. of Eagle Island, N. Mayo. 388 f. One spec. . . . . . . *Helga.*

This is the first record of this genus from Irish waters. The specimen is small, the disc measuring about 5 mm. in diameter. The moniliform arrangement of the arm-joints is very remarkable. The arm-spines are roughened and in some cases even thorny, and in this particular the specimen differs from Prof. Bell's description. J. A. Grieg, however, (Den Norske Nordhavs Exped., 1876-78, XXII., Christiania, 1893), mentions that the arm-spines of this species are very variable in this respect and figures two, one smooth and one thorny. The specimen was taken in the company of *Ophiactis Balli.*

OPHIOCOMIDAE.

Ophiocoma nigra (Abilg.)

40 miles W.N.W. of Cleggan Head, Co. Galway. 78 f. Two specs. . . . . *Helga.*
20 miles N. by W. of Eagle Island, N. Mayo. 70 f. Several. . . . . *Helga.*
40 miles W.N.W. of Cleggan Head, Co. Galway. 74½ f. Two large specs. . . . . . *Helga.*

Commoner in shallower water, but of smaller size.

OPHIOTHRICIDAE.

Ophiothrix fragilis (Abilg.)

40 miles N.W. ¼ N. of Achill Head, Co. Mayo.
220 f. Two specs. . . . . . . *Fingal.*

Many records from 50-130 fathoms. Very common inside the 50-fathom line.

Ophiothrix Lütkeni (Wyv. Thoms.)

This fine species is common off the west and south coast; it has been taken in nearly every expedition, often abundantly, at depths ranging from 75-315 fathoms.

STREPTOPHIURIDAE.

Ophiobyrsa hystricis (Lyman.)

56 miles off Dursey Head, Co. Kerry. 345 f.
Fragments in bad condition. . . . . *Flying Falcon.*
71 miles W. by S. of Fastnet, off C. Clear. 315 f. *Flying Fox.*
40 miles N.W. ½ N. of Achill Head, Co. Mayo.
220 f. juv (?). . . . . *Fingal.*
77 miles W.S.W. of Fastnet, off C. Clear. 400 f.
One spec. . . . . *Research.*

ECHINOIDEA.

CIDARIDAE.

Cidaris papillata (Leske.)

There are more records of this species from deep water off the west coast than of any other Echinoderm.

Wyville Thomson in his account of the Echinoidea of the *Porcupine* expedition, says that it was dredged in 100-400 fathoms wherever there was a gravelly, sandy, or hard bottom in a continuous belt from Faeroe to Gibraltar. Though not so abundant it was frequent in 600-800 fathoms, and a few small specimens from upwards of 1,000 fathoms.

It is often found in very large numbers; on a recent occasion eighty specimens were taken from the *Helga's* dredge.

A few specimens were dredged by the *Helga* in 91 fathoms on the Porcupine Bank; this is the shallowest water in which it has been found off the west coast.

Cidaris gracilis (Sladen.)

84 miles W. by N. of Fastnet, off C. Clear. 750 f.
One spec. . . . . *Flying Falcon.*

This species was described by Sladen from the single specimen taken in the above locality. Sladen himself remarks that it is "probably immature," and Prof. Bell is of the opinion that it is a young specimen of *C. purpurata*, Wyv. Thoms.

ECHINOTHURIIDAE.

Asthenosoma hystrix (Wyv. Thoms.)

W. coast of Ireland. Several stations. "Fragments of plates and spines." . . . . . *Porcupine.*
45 miles N.N.W. of Achill Head, Co. Mayo. 500 f. *Harlequin.*
64 miles N.W. ½ N. of Cleggan Head, Co. Galway.
199 f. 20 specs. Chocolate form. . . . *Helga.*
77 miles W.N.W. of Achill Head, Co. Mayo.
382 f. One spec. . . . . *Helga.*

A large number of specimens were taken by the *Harlequin*; they were of two distinct types of coloration—bright red and dark brown.

Phormosoma placenta (Wyv. Thoms.)

W. coast of Ireland. 500-800 f. "Fragments of spines." . . . . . . *Porcupine.*
84 miles W. by N. of Fastnet, off C. Clear. 750 f. *Flying Falcon.*
W. by S. of Fastnet, off Cape Clear. 1,000 f. Five specs. Spinulation destroyed. . . *Flying Fox*
54 miles N.W. of Achill Head, Co. Mayo. 500 f. *Fingal.*
45 miles N.N.W. of Achill Head, Co. Mayo. 500 f. *Harlequin.*
77 miles W.N.W. of Achill Head, Co. Mayo. 382 f. One spec. . . . . *Helga.*
54 miles W. by N. ½ N. Nly. of Tearaght Light, Co. Kerry. 454 f. One spec. . . . . *Helga.*
48 miles N.W. by W. ¾ W. of Tearaght Light, Co. Kerry. 337 f. One spec. . . . . *Helga.*

Probably rarer than the preceding species; single specimens usually found.

Phormosoma uranus (Wyv. Thoms.)

84 miles W. by N. of Fastnet, off C. Clear. 750 f. *Flying Falcon.* "A single fine example."

ECHINIDAE.

Echinus acutus (Lamk.)

Common up to 500 fathoms. Prof. Bell remarks that a specimen taken by the s.s. *Fingal* is very conical.

E. acutus var. norvegicus (Düb. and Kor.).

Almost as common as the typical form; it has been taken in 808 fathoms, and seems generally to occur in deeper water.

E. acutus var. microstoma (Wyv. Thoms.)

Not so common as the typical form, or as the var. *norvegicus*, but of frequent occurrence; on one occasion when the *Helga* was trawling in deep water off the Kerry coast small specimens of this form were found in such numbers as to choke the nets.

Echinus esculentus (L.)

35 miles W. ½ N. of Fastnet, off C. Clear. 80 f. *Lord Bandon* (1).
25 miles W.N.W. of Gt. Skellig, Co. Kerry. 110-120 f. . . . . *Lord Bandon* (1).
South of Galley Head, Co. Cork. 55 f. . . *Flying Fox.*
45-60 miles W. ½ N. of Dursey Head, Co. Kerry. 110 f. . . . . *Flying Fox.*
3-5 miles S.W. by S. of Gt. Skellig, Co. Kerry. 60-65 f. One spec. . . . . . . *Helga.*

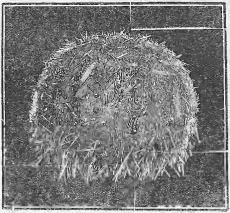
Rarely found outside the 50-fathom line. Some of these specimens probably belong to the next species.

Echinus tenuispinus (Mortensen.)

Porcupine Bank, 124 miles S.W. by W. ¼ W. of Cleggan Head, Co. Galway. 91 f. 3 specs. . *Helga.*
125 miles W.N.W. Nly. of Slyne Head, Co. Galway. 109 f. One spec., broken. . . . *Helga.*
40 miles W.N.W. of Cleggan Head, Co. Galway. 78 f. One spec. . . . . *Helga.*
20 miles N. by W. of Eagle Island, Co. Mayo. 72½ f. One spec. . . . . . . *Helga.*
40 miles N. W. by W. ⅜ W. of Cleggan Head, Co. Galway. 74½ f. One spec. . . . *Helga.*

This species has been recently described by Mortensen (Echinoidea of the Danish Ingolf Expedition, 1903, p. 180) from two specimens from the first of the above localities; his description runs thus:—

"The test is almost globular, especially in the larger specimen; the edge of the mouth not curved inwards. There are spines on the buccal plates; numerous, rather thick plates in the buccal membrane. No ocular plates reach to the periproct. Only every other ambulacral plate has a primary tubercle; on the other plates there is a rather large secondary tubercle in the inner end and one a little outside of the primary series near the pores; otherwise there are almost no tubercles in the ambulacral area. The pores reach quite to the edge of the area; each interambulacral plate has a primary tubercle, and moreover *ca.* 4—6



Echinus tenuispinus
(Mortensen).

secondary ones, which are, however, far from filling the plate, so that the test looks rather naked. The primary series are distinct. Miliary tubercles numerous. On the actinal side the tubercles are placed much more closely. Here the spines are rather long, directed straight downward, not flat or widened at the point; the abactinal spines short and fine Pedicellariae and spicules quite as in *Ech. esculentus*. The colour of the preserved specimens is white. After a communication from the Rev. Canon A. M. Norman, it is this species he has described as *Ech. esculentus* var. *tenuispina*, and so it gets the name of *Echinus tenuispinus* n. sp. It is, as seen by Norman, closely allied to *esculentus*, with which it agrees in the most important characters: primary tubercle only on every other ambulacral plate, and spines on the buccal plates; it is easily distinguished from the latter by having far fewer tubercles, among which the primary series are very distinct, and by its white colour—*esculentus* always seems to keep the colour in spirit. I am decidedly of the opinion that it must be regarded as an independent species not only as a variety of *esculentus*. It differs considerably as to habitus from this species, among whose forms I know no specimens with which it may be confounded. What I have interpreted as var. *tenuispinus* is a peculiar form with short fine spines, but with the usual colour of the test (from the Faröe Islands); accordingly it is not identical with Norman's var. *tenuispinus*."

The occurrence of this species, so closely allied to a littoral form, on such a locality as the Porcupine Bank is worthy of attention.

The measurements of six of the known specimens (in mm.) are as follows:—

Diameter.	Height.	
57	45	} Mortensen's specimens.
33	23	
71	64	
70	59	
59	47	
44	36	

One specimen too broken for measurement.

Echinus gracilis (Düb. and Kor.)

About 40 miles W.N.W. of Valentia. 110 f.	*Porcupine.*
45-60 miles W. ½ N. of Dursey Head, Co. Kerry, 250 f. Four specs.	*Flying Fox.*
54 miles N.W. of Achill Head, Co. Mayo. 500 f. Eight specs.	*Fingal.*
35 miles N. by W. of Achill Head, Co. Mayo. 250 f.	*Harlequin.*
45 miles N.N.W. of Achill Head, Co. Mayo. 500 f.	*Harlequin.*
50 miles N.W. by N. of Cleggan Head, Co. Mayo. 120 f. One spec. (F. J. B.).	*Helga.*

CLYPEASTRIDAE.

Echinocyamus pusillus (O. F. Müll.)

"Generally distributed."	*Porcupine.*
Dingle Bay, Co. Kerry. 54 f. (More 1870).	—
Off Bull Island, Dursey Head, Co. Kerry. 60 f.	*Argo.*
30 miles W.N.W. of Cleggan Head, Co. Galway. 70 f. Four specs.	*Helga.*
42 miles W. by N. of Bray Head, off Valencia. 175 f. One spec.	*Helga.*
Porcupine Bank, 120 miles W.N.W. of Slyne Head, Co. Galway. 91 f. One spec.	*Helga.*

Rarely taken outside the 50-f. line.

SPATANGIDAE.

Spatangus purpureus (O. F. Müll.)

Of common occurrence; has been taken up to 400 f. (*Research*).

Sometimes single specimens are found; sometimes the dredge brings up two or three hundred at a time. The *Helga* has dredged very typical examples of this species on the Porcupine Bank.

Spatangus Raschi (Loven.)

Common. There are more records of this species than of the preceding. The greatest depth at which it has been taken is 500 f., at which depth it has twice been found (*Fingal* and *Harlequin*).

S. Raschi was dredged by the *Lord Bandon* (1st exp.) in 70-90 f. Like *S. purpureus*, enormous numbers are often taken in a single haul.

Echinocardium pennatifidum (Norman).

Porcupine Bank, 120 miles W.N.W. of Slyne Head, Co. Galway. 91 f. One spec.	*Helga.*

This species has once previously been recorded from Irish waters, when it was found by Mr. W. I. Beaumont in 20-45 fathoms off Valentia Harbour. Although this Echinoid has been taken in 120 fathoms, it would seem to be usually an inshore species, and its occurrence on the Porcupine Bank, 120 miles from land, is thus of great interest.

The specimen occurred in company with *Spatangus purpureus*, which is very common on the bank.

Echinocardium flavescens (O. F. Müll.)

12 miles S.W. of Great Skellig, Co. Kerry. 70-79 f. . . . . *Lord Bandon* (1).
14 miles W. by N. ½ N. of Bolus Head, Co. Kerry. 80 f. . . . . *Fingal.*

Brissopsis lyrifera (Forbes.)

W. coast of Ireland (?). 50-250 f. . . . . *Porcupine.*
12 miles S.W. of Great Skellig, Co. Kerry. 70-79 f. . . . . *Lord Bandon* (1).
5-8 miles W. of Great Skellig, Co. Kerry. 70-80 f. Several. . . . . . . *Lord Bandon* (2).
(Locality lost). 54 f. . . . . *Flying Falcon.*

Wyville Thomson, in his account of the *Porcupine* Echinoidea, says that large specimens of this species are common up to 250 f., and smaller and more delicate specimens occur up to 2,090 f.

A List of the Expeditions and Stations from which the Echinoderms included in this paper were taken, with Lat. and Long.

N.B.—All bearings magnetic.

"Porcupine" Expedition, 1869.

Station No.		Depth, fathoms.	Lat. N.	Long. W.
?	40 miles W.N.W. of Valentia, co. Kerry.	110	51° 53′ (?)	11° 30′ (?)
2	83 miles W. by N. of Dursey Head, co. Kerry.	808	51° 22′	12° 25′
4	115 miles N.W. by W. ¾ W. of Skelligs, co. Kerry.	251	51° 56′	13° 39′
6	56 miles N.W. by N. of Valentia, co. Kerry.	90	52° 25′	11° 40′
7	55 miles N.W. of Valentia, co. Kerry,	159	52° 14′	11° 48′
8	71 miles W. by S. ¼ S. of Achill Head, co. Mayo.	106	53° 15′	11° 51′
15	39 miles W.N.W. of Black Rock, off Blacksod Bay.	422	54° 5′	12° 17′
31	46 miles N. by W. ½ W. of Eagle Island, North Mayo.	1,360	54° 53′	10° 56′
34	94 miles S. ¾ E. of Fastnet, off Cape Clear.	75	49° 51′	10° 12′
43	135 miles W. by S. ½ S. of Fastnet, off Cape Clear.	1,207	50° 1′	12° 26′
45	72 miles W. ½ N. of Cape Clear,	458	51° 1′	11° 21′
45*a*	About 62 miles W. ¾ N. of Cape Clear,	180	51° 10′(?)	11° 8′(?)

"Lord Bandon" 1st Expedition, 1885.

Station No.	——	Depth, fathoms.	Lat. N.	Long. W.
1	35 miles W. ½ N. of Fastnet, off Cape Clear.	75–90	51° 15′	10° 31′
5	25 miles W.N.W. of Gt. Skellig, co. Kerry.	110–120	51° 46′	11° 13′
6	12 miles S.W. of Gt. Skellig, co. Kerry.	70–79	51° 36′	10° 41′

"*Lord Bandon*" *2nd Expedition*, 1886.

Station No.	—	Depth, Fathoms	Lat. N.	Long. W.
log. 44	38 miles W. ½ S. of Dursey Head, co. Kerry.	108	51° 18′	11° 9′
log. 45	53 miles W. ½ S. of Dursey Head, co. Kerry.	325	51° 11′	11° 31′
log. 49	42 miles W. by S. ½. S. of Gt. Skellig, co. Kerry.	160	51° 20′	11° 26′
log. 53	5–8 miles W. of Gt. Skellig, co. Kerry.	70–80	51° 46′	10° 42′*
log. 56	29½ miles W. by S. of Dursey Head, co. Kerry.	93	51° 19′	10° 55′
log. 58	43½ miles W. ¾ S. of Dursey Head, co. Kerry.	110	51° 13′	11° 15′
log. 59	50 miles W. ½ S. of Dursey Head, co. Kerry.	214	51° 12′	11° 26′

* Approximately.

"*Flying Falcon*" *Expedition*, 1888.

Station No.	—	Depth, fathoms	Lat. N.	Long. W.
log. 67	56 miles W. by S. ¼ S. of Dursey Head, co. Kerry.	345	51° 2′	11° 27′
log. 69	86 miles W. by N. of Fastnet, off Cape Clear.	750	51° 1′	11° 50′
log. 72	11 miles S. of Glandore, co. Kerry,	54	51° 20′	9° 2′
log. 73	(Locality lost), ...	50	—	—

"*Flying Fox*" *Expedition*, 1889.

Station No.	—	Depth, fathoms.	Lat. N	Long. W.
1	71 miles W. by S. of Fastnet, off Cape Clear.	315	50° 46′	11° 11′
2	W. by S. of Fastnet, ...	1,000	—	—
3	45–60 miles W. ½ N. of Dursey Head, co. Kerry. (Approximately).	110	51°-51° 35′	11°-12° 10′
4		250		
5		500		
7		500		
8	37 miles W. of Bull Rock, co. Kerry,	100	51° 22′	11° 9′
9	47 miles W. of Bull Rock, co. Kerry,	150–180	51° 17′	11° 27′
10	S. of Galley Head, ..	55	–	—
11	S. of Galley Head, ..	55	—	--

"*Fingal*" *Expedition*, 1890.

Station No.	——	Depth, fathoms.	Lat. N.	Long. W.
63	40 miles N.W. ¼ W. of Achill Head, co. Mayo.	220	54° 12′	11° 24′
64	30 miles N.W. ¼ W. of Achill Head, co. Mayo.	144	54° 7′	11° 4′
70	54 miles N.W. of Achill Head, co. Mayo.	500	54° 20′	11° 41′
71	35 miles N.W. by N. of Achill Head, co. Mayo.	175	54° 16′ 30″	11° 6′
72	20 miles N.W. by N. of Achill Head, co. Mayo.	126	54° 10′	10° 45′
114	14 miles W. by N. ½ N. of Bolus Head, co. Kerry.	80	51° 45′	10° 43′

"*Research*" *Expedition*, 1890.

Station No.	——	Depth, fathoms.	Lat. N.	Long. W.
1	67 miles W. ½ S. of Fastnet, off Cape Clear.	200	50° 50′ 15″	11° 12′ 30″
2	77 miles W.S.W. of Fastnet, off Cape Clear.	400	50° 29′ 26″	11° 4′
3 *	108 miles S.W. ½ W. of Fastnet, off Cape Clear.	200	49° 50′ 2″	11°
7	60 miles S.W. ½ S. of Fastnet, off Cape Clear.	70	50° 24′ 45″	10° 7′ 30″
8	62 miles S.W. ½ S. of Fastnet, off Cape Clear.	70	50° 22′ 21″	10° 7′ 30″

* N.B.—Stations 4, 5, and 6 are below the southern boundary of the British area.

"*Harlequin*" *Expedition*, 1891.

Station No.	——	Depth, fathoms.	Lat. N.	Long. W.
125	40 miles W. of Bolus Head, co. Kerry.	115	51° 31′	11° 15′
142	6 miles W. of Inishmore, Aran Islands.	50	53° 5′	9° 52′
201	45 miles N.N.W. of Achill Head, co. Galway.	500	54° 33′	11° 12′
203	35 miles N. by W. of Black Rock, off Blacksod Bay.	250	54° 34′	10° 48′

"*Helga*," 1900–1904.

—	Depth, fathoms.	Lat. N.	Long. W.
70 miles S.W. ½ W. of Fastnet, off Cape Clear.	91½	50° 24′	10° 31′
75 miles S.W. by W. ½ W. of Fastnet, off Cape Clear.	190	50° 27′ 30″	10° 57′
27 miles W. by N. ¼ N. of Bray Head, Valentia, co. Kerry.	100	51° 49′	11° 9′
42 miles W. by N. of Bray Head, Valentia, co. Kerry.	175	51° 46′	11° 33′
7 miles S. by W. of Tearaght Lighthouse, co. Kerry.	44–53	51° 57′	10° 39′
32 miles W. ¼ S. of Tearaght Lighthouse, co. Kerry.	129	51° 50′	11° 26′
54 miles W. by N. ½ N. Nly. of Tearaght Lighthouse, co. Kerry.	454	52° 1′ 30″	12° 7′ 30″
50 miles W.N.W. of Tearaght Lighthouse, co. Kerry.	396	52° 3′ 30″	12°
50 miles W.N.W. of Tearaght Lighthouse, co. Kerry.	327	52° 4′	12° 3′
39 miles W.N.W. Nly. of Tearaght Lighthouse, co. Kerry.	244½	52° 6′	11° 44′
50 miles W.N.W. Nly. of Tearaght Lighthouse, co. Kerry.	375	52° 6′	12°
48 miles N.W. by W. ¾ W. of Tearaght Lighthouse, co. Kerry.	337	52° 7′	11° 58′
3–5 miles S.W. by S. of Great Skellig, co. Kerry.	60–65	51° 42′	10° 35′
6½ miles W. by S. of Skelligs, co. Kerry,	72	51° 43′ 30″	10° 43′
50 miles W.N.W. of Slyne Head, co. Galway.	112	53° 24′ 30″	11° 38′
80 miles W.N.W. of Slyne Head, co. Galway.	180	53 26′	12° 29′
Porcupine Bank, 109 miles W. by N. ½ N. of Cleggan Head, co. Galway.	120	53° 26′	13° 12′
Porcupine Bank, 124 miles W. by N. ½ N. of Cleggan Head, co. Galway.	91	53° 24′	13° 34′
Porcupine Bank, 120 miles W.N.W. of Slyne Head, co. Galway.	91	53° 27′	13° 37′
40 miles W. by S. of Cleggan Head, co. Galway.	76	53° 11′	11° 3′
125 miles W.N.W. Nly. of Slyne Head, co. Galway.	109	53° 33′	13° 39′
112 miles N.W. by W. ¾ W. of Slyne Head, co. Galway.	135	53° 38′	13° 19′
20 miles W.N.W. of Cleggan Head, co. Galway.	65–72½	53° 34′	10° 41′
30 miles W.N.W. of Cleggan Head, co. Galway.	70–78	53° 34′	10° 58′
40 miles W.N.W. of Cleggan Head, co. Galway.	70–78	53° 34′	11° 15′
50 miles W.N.W. of Cleggan Head, co. Galway.	116–120	53° 34′	11° 42′
64 miles N.W. ¼ W. of Cleggan Head, co. Galway.	199	53° 52′	11° 56′
40 miles N.W. by N. of Cleggan Head,	105	53° 56′	11° 4′

"*Helga*," 1900–1904—*continued.*

—	Depth, fathoms.	Lat. N.	Long. W.
50 miles N.W. by N. of Cleggan Head, co. Galway.	120	54° 2′	11° 17′ 30″
77 miles W.N.W. of Achill Head, co. Mayo.	382	53° 58′	12° 30′
81 miles W. ½ N. of Eagle Island, co. Mayo.	220	53° 54′	12° 19′
50 miles W.N.W. of Eagle Island, co. Mayo.	388	54° 17′	11° 33′
31 miles N.N.W. wly. of Eagle Island, co. Mayo.	355	54° 35′*	10° 54′*
20 miles N. by W. of Eagle Island, co. Mayo.	70–72½	54° 34′	10° 25′

* Approximately.

ADDENDUM.

ECHINODERMS FOUND ON OR NEAR THE ROCKALL BANK.

The Rockall Bank is situated about 230 miles N.W. ½ W. of the extreme north-east of Co. Mayo; lat. 57° 36′, long. 13° 40′.

It is separated by a deep channel of 1,000-1,700 fathoms from the west coasts of the British Isles. It is also cut off from Iceland by the 1,000 fathom-line, while a comparatively narrow area, with soundings of 500-700 fathoms, connects it with the Faeroe Bank and Wyville Thomson Ridge.

Only on two occasions has any dredging been attempted on this ground, and consequently a total of 23 spp. is all that can be given.

In 1865 the *Porcupine* dredged in a few stations off Rockall in depths of 420-1,215 fathoms.

The only definite attempt to investigate the Rockall fauna was conducted in the *Granuaile* in June, 1896, by the Royal Irish Academy, and in that month two visits were made to the locality.

Five dredgings were made on the bank as follows:—

1 mile off Rockall, . . .	60 fathoms.
15 miles S. of Rockall, . .	80-100 fathoms.
S. of Rockall, . .	100 fathoms.
16 miles S.E. by E. of Rockall,	120 fathoms.
17 miles E. by S.½S. of Rockall,	130 fathoms.

Sladen in his list of these Echinoderms (Trans. R.I.A., 1897) mentions no localities or depths, but it will be seen from the above list of stations that all the dredgings were within twenty miles of Rockall, and at depths of 60-130 fathoms.

The occurrence of such a typically littoral species as *Echinus miliaris* is of the greatest interest. This Echinoderm had not previously been found below 45 fathoms, and its presence indicates that the theory that Rockall is the last relic of a mountainous island, now almost wholly submerged, is probably correct. Shells of many littoral species of mollusca were also found in the same dredgings.

HOLOTHURIOIDEA.

Cucumaria Hyndmani (Thomps.)

Lat. 56° 13′ N., long. 14° 18′ W. 420 f. Three specs. *Porcupine.*
Lat. 56° 7′ N., long. 14° 19′ W. 630 f. Three specs. *Porcupine.*

Thyone fusus (O. F. Müll.)

Granuaile.

Holothuria tremula (Gunnerus.)

Granuaile.

CRINOIDEA.

Antedon bifida (Penn.)

Granuaile.

ASTEROIDEA.

Pontaster tenuispinis (Düb. and Kor.)

Granuaile.

Plutonaster Pareli (Düb. and Kor.

Granuaile.

Astropecten irregularis (Penn.)

Granuaile.

Luidia Sarsi (Düb. and Kor.)

Granuaile.

Hippasterias phrygiana (Parelius.)

Granuaile.

Stichaster roseus (O. F. Müll.)

Granuaile.

Henricia sanguinolenta (O. F. Müll.)

Granuaile.

Brisinga coronata (G. O. Sars.)

Lat. 56° 7′ N., long. 14° 19′ W. 630 f. . . *Porcupine.*

OPHIUROIDEA.

Ophiura Sarsi (Lütk.)

Granuaile.

Ophiactis Balli (Thompson.)

Granuaile.

Ophiopholis aculeata (L.)

Granuaile.

Ophiothrix fragilis (Abilg.) *Granuaile.*

ECHINOIDEA.

Cidaris papillata (Leske.) *Granuaile.*

Asthenosoma fenestratum (Wyv. Thoms.)

"Fragments off Rockall." . . . . . . *Porcupine.*

Echinus norvegicus (Düb. and Kor.) *Granuaile.*

Echinus miliaris (Linn.) *Granuaile.*

Spatangus purpureus (O. F. Müll.) *Granuaile.*

Pourtalesia phyale (Wyv. Thoms.)

Lat. 56° 44′ N., long. 12° 52 W. 1,215 f. . *Porcupine.*
Also found off Kerguelen.

Pourtalesia miranda (A. Ag.)

Lat. 56° 44′ N., long. 12° 52′ W. 1,215 f. . . *Porcupine.*
Also found in the Florida gulf-stream and off Havana.

Only two specimens of *Pourtalesia* were taken in 1,215 f. by the *Porcupine.* Wyville Thomson calls them both *P. phyale.* Agassiz, in his Rep. Chall. Echin., retains *P. phyale*, and mentions it as having been taken off Rockall, but in addition he creates a new species, *P. miranda.* The only solution of the difficulty is that of the two specimens taken off Rockall in 1,215 fathoms, one belongs to each species.

In addition to these the *Porcupine* dredged *Holothuria tremula* from 1,476 f. in lat. 55° 40′ N., long. 12° 50′ W. This record increases the bathymetric range of the species by over 800 fathoms. *Plutonaster Pareli* and *Cheilaster fimbriatus* were dredged from 1,360 fathoms in lat. 56° 15′ N., long. 11° 25′ W., also by the *Porcupine.*

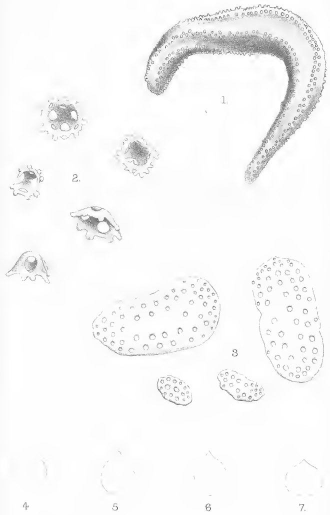
EXPLANATION OF PLATE XXXV.

Cucumaria elongata (Düb and Kor.)

Fig. 1. Entire animal with tentacles retracted . . . × 2.
Fig. 2. Cup-shaped spicules from outer layer of skin . . × 290.
Fig. 3. Rectangular spicules from inner layer of skin . . × 80.

Ophiura signata (Verrill.)

Fig. 4. Mouth-shield, as figured by W. E. Hoyle.
Fig. 5. Mouth-shield of the *Flying Falcon* specimen.
Fig. 6. Mouth-shield of the *Helga* specimens.
Fig. 7. Mouth-shield of Canon Norman's specimen.



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Figs 1-3. Cucumaria elongata, Dub and Kor.
Figs 4-7. Ophiura signata, Verrill

APPENDIX, No. VII.

THE MARINE FAUNA OF THE WEST COAST OF IRELAND, MISCELLANEOUS NOTES.

i.—Additions to the list of Nudibranchiate Molluscs of Ballynakill Harbour, Co. Galway.

ii.—Rediscovery of the Nudibranch *Alderia modesta* (Lòven).

iii.—Occurrence of the Floating Barnacle, *Lepas fascicularis* (Ellis and Sol.),

by G. P. FARRAN, B.A.

iv.—On *Nebalia typhlops*, G. O. Sars.

v.—On Stomatopod Larvae from the West Coast of Ireland.

vi.—Enteropneusta from the West Coast of Ireland,

by W. M. TATTERSALL, B.Sc.

i.—ADDITIONS TO THE LIST OF NUDIBRANCHIATE MOLLUSCS OF BALLYNAKILL HARBOUR, CO. GALWAY.

BY

G. P. FARRAN, B.A.

Since the publication of the Annual Report for 1901, two additions have been made to the list of Nudibranchs of Ballynakill Harbour, and incidentally to the fauna of Ireland, viz., *Staurodoris verrucosa* (Cuv.) and *Styliger bellula* (d'Orb.), the former record being also the first from the British marine area.

Staurodoris verrucosa (Cuv.).

A single specimen of this species was taken by the dredge on Fahy Bar, Ballynakill (1-2 fath.), in April, 1903. The following description was taken from the animal while still alive:—

Length, 1·7 cm. Body long, oval, moderately depressed, lateral margins of cloak bent up, irregularly frilled. Back covered with large unequal knob-shaped tubercles, about equal in size to those of an *Archidoris tuberculata* of 4 cm. Head with broad flattened tentacles, grooved ventrally. Rhinophores short, 7-8 laminate, directed laterally outwards when extended, arising from short tubular sheaths, the margins of which are cut into one small (anterior) and three larger lappets. Branchiae 12 in number, stout, opaque, simply pinnate, set very far back, and forming a dorsiventrally flattened oval.

Colour, pale yellow, with brown pigment on the branchiae and on the tips of the tubercles.

Liver large, showing distinctly, of a pale blue colour.

This species can easily be recognised by its very large dorsal tubercles, numerous (12-16) simply pinnate branchiae, and remarkable rhinophore sheaths.

The radula resembles that of *Archidoris tuberculata*.

It appears to be widely distributed in the Mediterranean, and Bergh* further gives its distribution as Western and Eastern Atlantic.

There is a moderately good figure of the animal, uncoloured, given in Cuvier's "Memoires des Molluscs," Doris, Pl. 1, Fig. 4-7.

Styliger bellula (d'Orb.).

A few specimens were taken at intervals during 1901 and 1902 crawling over the fronds of *Laminaria saccharina* from various parts of Ballynakill Harbour, and on one occasion a considerable number were found in a zostera bed situated on the E. side of the channel off Ross Point.

This species was added to the British list in 1892 by Mr. W. Garstang,† who captured several specimens in Cawsand Bay, Plymouth, bnt I am not aware of any subsequent British records. There is an excellent figure of the animal given in the *Fauna der Kieler Bucht*‡ by Meyer and Möbius, who there described it as a new species under the name of *Embletonia Mariae*. I have recorded it under the name of *S. bellula* rather than that of *S. Mariae*, as it seems to me certain that the two species are identical, although Bergh, while suggesting that *S. Mariae* is probably a synonym of *S. bellula*,§ yet in a subsequent paper‖ seems to imply that they may be distinct. I am only acquainted with *S. bellula* through Adams' reproduction of d'Orbigny's figure,¶ as I have been unable to consult the original description.**

Lamellidoris luteocincta (M. Sars).

Since describing a small nudibranch from Ballynakill in last year's Annual Report under the name of *Doris Beaumonti* I have ascertained that it had already been described by M. Sars in 1870 as *D. luteocincta*, of which the name *D. Beaumonti* must now be regarded as a synonym.

M. Sars' description is published in the "Nyt. Mgz. fur Naturvetensk," xvii. 1870, p. 190, and the radula is figured, under the name of *Onchidoris luteocincta* in G. O. Sars' "Norges Arktiske Fauna," I. Mollusca. Pl. xiv., fig. 3.

Sars describes the animal as possessing a small velum, the labial tentacles being obsolete. It was taken by him at Vallö in the Christiania Fjord sparingly at from 10 to 20 fath.

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ii.—REDISCOVERY OF THE NUDIBRANCH

Alderia modesta (Löven.)

BY

G. P. Farran, B.A.

It may be of interest to record the recapture of this little nudibranch in Ireland, where it had not been met with since it was taken in 1846 by Allman in a marsh near Skibbereen, Co. Cork.

The animal has now been met with in considerable numbers at the Department's experimental oyster ponds at Ardfry, Co. Galway, near the head of Galway Bay. The exact locality in which it was found is a

* Bergh, *Malacologische Untersuchungen*.
† *Jour. Mar. Biol. Assoc.* Vol. II., N.S., p. 333.
‡ Bd. I., 1865. *Opisthobranchiata*, p. 16.
§ Semper, *Reisen im Archipel. de Philipp.* *Malac. Untersuch.*, 1872, p. 139.
‖ *Verhand. Zoo. Bot. Gesellsch. Wien.* Bd. 35, 1885, p. 10.
¶ Recent Mollusca. Pl. LXVI., fig. 7.
** *Mag. de Zoologie*, 1837, p. 12, 14, pl. c. VIII.

stretch of marshy grass at the margin of the pond, just at the level of high water at spring tides. In this there are a number of hollows or depressions where the grass is absent, which are floored with damp mud, bare, or with a coating of cladophora, conferva, and other similar algæ. It is in these hollows that *Alderia modesta* occurs in some numbers.

The recorded distribution of the species is very limited. It has been taken at Monmouth, and, on the Continent, at Bohuslän in Sweden, whence it was described by Loven; near Rodberg in Norway, from which place Canon Norman records it;* and at Helsingfors in Finland.†

Its scarcity may, perhaps, be accounted for by the want of a suitable habitat in a great many districts and the constant liability of a colony to extinction by an unusually low spring tide, combined with a prolonged period of hot sunshine, as it seems to choose a spot which is reached by the tide but once a fortnight.

The specimens of *Alderia* from Ardfry are all of very small size, none of them reaching more than ·5 cm. in length. They agree closely with Alder and Hancock's figure in colour and form.

In company with the above there were found numerous specimens of *Limapontia capitata* of very small size. This species, while exhibiting a liking for situations similar to those which *Alderia* seemingly invariably occupies (it has been recorded by Garstang‡ from a spot on the Lancashire coast, almost exactly similar to that at Ardfry), yet is also frequently found between tide marks, and has been recorded by Gamble§ as having been dredged in about four fathoms at Valencia, though Mr. Beaumont informs me that, as far as his experience goes, the latter occurrence is unique, and that the species is always found between tide marks, occurring at Plymouth generally on corallines from tide pools.

iii.—OCCURRENCE OF THE FLOATING BARNACLE, **Lepas fascicularis** (Ellis and Sol.)

BY

G. P. Farran, B.A.

During the quarterly cruise of the *Helga* in August, 1903, floating colonies of the above species were seen in large numbers off the west coast of Ireland. Their distribution in that area, as far as noted, is rather curious.

They were first observed on August 10th, when large numbers of them were passed between thirty and fifty miles W.N.W. (magn.) of Cleggan Co. Galway, only a few being seen inside the thirty mile limit.

On August 13th the shoal was passed through on a line N.N.W. from Rathlin O'Beirne, Co. Donegal; the barnacles being moderately plentiful between five and fifteen miles from land, though very few were seen between fifteen and fifty miles off shore.

On August 17th the *Helga* again traversed the line running W.N.W. from Cleggan; but on this occasion the greatest numbers were seen between ten and twenty miles from shore, the numbers between twenty and fifty miles being much fewer than those inside.

Finally, a few specimens were seen on August 19th, fifty miles W.N.W. of Tearaght, Co. Kerry, where none had been observed on the previous visit of the *Helga* on August 7th.

During August, 1904, when the *Helga* went over almost the same ground, no sign of the species was seen. *Lepas fascicularis* is not a species which could be overlooked if it were present in any numbers,

* *Ann. & Mag. N.H.*, Ser. 6, Vol. XII., p. 351.
† *Meddel. Soc Fauna Flora Fennica*, Huft 28B, p. 40-41 (*fide* Zool. Anzeiger).
‡ *Jour. Mar. Biol. Assoc.*, Vol. I., n.s. 1890, p. 422.
§ *Proc. Royal Irish Acad.*, 3rd Ser., Vol. V., No. 5, p. 852.

as the large white floating clumps at once attract the attention, and can be seen from a considerable distance. The size of the colonies seen on the above-mentioned occasions varied from about three to seven inches in diameter, the original foundation being in all observed cases a small fragment of *Fucus*.

The Fulmar Petrels, which are invariably seen round the ship at any distance over thirty miles from shore, seemed to spend most of their time pecking at the floating colonies, probably feeding on the marine Isopod, *Idotea metallica*, several specimens of which were obtained among the stalks of the barnacles.

The occurrence of this species in such an immense swarm off the west coast of Ireland seems to be most exceptional, as no signs were seen of it during the Fishery Survey cruises of the ss. *Fingal* and *Harlequin* in 1890 and 1891, nor during the various expeditions made off the west coast by the ss. *Helga* in 1901 and 1902. *Lepas fascicularis* appears to be widely spread over the great oceans of the world on both sides of the equator. It has been recorded from the N. and S. Atlantic, the N. and S. Pacific, and the Indian Ocean. Darwin, in his Monograph,* mentions the account of Dr. Coates, who, for several days, sailed through an infinite number of specimens in the Southern Atlantic, and the *Challenger* had a similar experience in the Pacific on her cruise from Japan to the Sandwich Islands.†

IV.—ON **Nebalia typhlops**, G. O. Sars.

BY

W. M. TATTERSALL, B.Sc.

Nebalia typhlops was described by G. O. Sars in 1869 (Christ. Vid. Selsk. Fordh., 1869), from a female specimen taken between 150-200 fathoms off Lofoten, Norway. Writing again in 1896 (Fauna Norvegiae, Bd. I., Phyllocarida), Sars mentions that up till then only three specimens, all females, were known, and that out of Norway it had never been recorded. Dr. Calman has very kindly called my attention to a record of this species in the Mediterranean by Lo Bianco (Naples Mittheilunggen, XVI., 1903). This, as far as I know, completes the records of this species, and males up till now were quite unknown.

Eleven females and two males of this interesting form were washed from sand brought up in a tow-net attached to a trawl, fishing 60 mi. W. of Achill Head, in 199 fathoms of water, in August, 1901, while a male and a female specimen have since been taken in tow-nets attached to trawls fishing 50 mi. W. of Cleggan Head, County Galway, in 120 fathoms of water.

This species differs from the common species, *N. bipes* (1) in the form of the frontal plate, which in the latter is obtusely rounded, while in *N. typhlops* it ends in a pointed spiniform prominence; (2) in the eyes, which in *N. typhlops* are very imperfectly developed, without trace of visual elements and pigment.

A description of the male, with figures, will be published later. The most conspicuous sexual differences exhibited by the species are the relative greater length of the superior antennae, the great length of the inferior antennae, which in the male are as long as the entire body, and great development of the caudal rami, which in the male often reach half the length of the rest of the body; while in the female they are only about as long as the last two segments of the posterior division of the body.

This species is for the first time added to the British list, while the range of geographical distribution is considerably increased. It is now known from Norway, Mediterranean, and the west coast of Ireland, in depths ranging from 120 to 200 fathoms.

* Monogr. of Cirripedia, Ray. Soc., 1851,—Lepadidae, p. 94.
† *Challenger* Reports, Vol. VIII., pt. xxv.—Cirripedia, p. 41

V.—ON STOMATOPOD LARVAE FROM THE WEST COAST OF IRELAND.

BY

W. M. TATTERSALL, B.Sc.

Records of Stomatopoda, in either adult or larval form, from British waters are few in number. Those of the adult are confined to two or three captures of *Squilla Desmarestii* and *S. mantis* from the English Channel, while lately also the former species has been taken in the North Sea (F. J. Bell, Jour. Mar. Biol. Assoc., n. s., Vol. VI., No. 3, 1902). This paucity of records is without doubt due to the peculiar habits of the group, which are fossorial forms of retiring habits and extremely active movements. It is thus very seldom that they are captured in the trawl or dredge.

A fruitful source of such forms is generally to be found in the stomachs of bottom-living fish like the ray. Burrowing macrurous decapods like *Axius* and *Callianassa* of apparently similar habits, but possibly much less active, are frequently met with in such situations. In localities in which they occur, they appear to form the main article in the diet of the ray.* Whether Stomatopods are less palatable than these decapods, or whether, as is much more likely, they are too active and too wary for the ray, the fact remains that they are seldom found in their stomachs.

Larval Squillidae are much more commonly met with in British waters than the adult, though records of them are few. Mr. Holt tells me they are common enough at Plymouth, and the "International" have recorded their capture in tow-nets in the English Channel in August, 1903. An Erichthus larva has also been taken once in the North Sea (*vide* Bell, *loc. cit.*).

The observations made by the Department of Agriculture for Ireland, on the west coast during a period of five years, tend to show that Stomatopod larvae are neither rare nor a chance factor in our fauna, but rather that they form a constant part of the pelagic life of our waters. Every autumn during the five years over which the observations have extended, from the middle of August to the beginning of October, larval Stomatopods have occurred in the tow-nets. This is by no means certain proof of the proximity of adult Stomatopoda, in numbers, to our coast, as the larvae, owing to the long duration of the larval life, are capable of wide distribution by oceanic currents. Their regular occurrence, however, points in this direction.

There are two typical and distinct types of larvae among Stomatopoda, the *Alima* and the *Erichthus*. Both types occur off the west coast of Ireland, the latter type being much more commonly met with.

The *Alima* larva was represented by only six specimens, all belonging to the same species and varying in length from 8·5 to 23 mm.

Larva 23 mm.—The carapace has a long anterior rostral spine reaching beyond the antennular peduncle, two moderately long antero-lateral spines, two very long postero-lateral spines, and a short posterior median dorsal spine. There are two small spinules immediately posterior to the antero-lateral spines, and one immediately in front of the origin of the postero-lateral spines, while the latter bear a small spinule about the centre of their length. All the six abdominal segments are developed, and all have their postero-lateral angles drawn out into acute spines, while the sixth segment has two short curved spines on the median posterior dorsal border. The telson is longer than broad, rather deeply notched in the centre, with six well developed marginal spines. Between

* In Galway Bay, the stomachs of *Raia clavata* are found to contain almost solely *Axius stirynchus* and *Callianassa subterranea*.

the submedian spines there are seventeen denticles on each side of the centre, while eleven intermediate and one lateral denticle are present on each side.

The uropoda are well developed, with four small teeth on the outer edge of the external ramus, and with the inner tooth of the ventral prolongation slightly longer than the outer one. The dactylus of the raptorial claw is still without teeth, and there is a strong spine on the basal part of the propodus.

All the swimming feet are well developed and the antennule has three flagella. The larva is considerably advanced, and very near to the adult stage. It is small compared to many of Brooks' *Alimae* of similar development, and the conclusion is that it is the larva of a comparatively small adult. The smaller larvae belonging to this species, in the collection, only differ from this in the stage of development of the limbs and segments of the body. The submedian denticles of the telson are found to vary between seventeen and twenty-two, while the intermediate denticles vary between eleven and thirteen. There is never more than one lateral denticle.

The number of teeth on the outer uropod varies with the age of the larva, and the small spines behind the antero-lateral spines of the carapace would appear to be absent in the younger forms.

This larva is the young of a species of the genus *Squilla*, as Brooks has shown that all *Alimae* are the young of this genus. To which species of the genus they belong I have not been able to determine, nor have I identified them with any described *Alima*. This I hope to do later, but I may mention that it is one of the few *Alimae* which have a posterior median spine to the carapace.

The *Erichthus* larva was represented by a great number of specimens, all belonging to one species, in all stages of development, from the Erichthoidina stage to well-advanced larvae, varying in size from 5 mm. to 19 mm. They belong, I believe, to the genus *Gonodactylus*, and are therefore *Gonerichthi*, as Brooks has named them. The genus *Gonodactylus* is new to the British list.

Larva 19 *mm*.—The carapace is shallow, as that of most *Gonerichthi* is, and not very wide. It has a very long rostral spine, two short antero-lateral spines, two long postero-lateral spines, and a short median posterior-dorsal spine. It has also a short spine arising slightly below and in front of the postero-lateral spines. This latter spine is characteristic of *Gonerichthi* among *Erichthus* larvae. The carapace is thus exactly like that of the *Alima* described above, but unlike that *Alima* and all *Alimae* generally, it entirely covers all the thoracic segments, while in the *Alima* the last three or four thoracic segments are exposed.

All the six abdominal segments are developed, but only the fifth has its posterior-lateral angles drawn out into spines, the remaining five having them rounded. The sixth segment has (as in all *Gonerichthi*) two small spines on the median posterior-dorsal border, but its lateral angles are (unusually) rounded.

The telson is wider than long, slightly notched in the middle, with six well-developed marginal or primary spines. Between the submedian spines, on each side of the centre, are fourteen denticles, while there are two intermediate and one lateral denticle on each side. The uropoda are well developed, with four teeth on the outer edge of the external ramus, and the *outer* spine of the ventral prolongation much longer than the inner.

The remaining appendages are all well developed. The raptorial claw is without teeth, and bears a small spine on the base of the propodus.

The younger larvae of this species in the collection differ from this only in the stage of development of the limbs and segments, and in the fewer number of teeth in the outer uropod. There is always one lateral and two intermediate denticles, while the sub-median ones do not seem to vary very much on either side of fourteen.

These larvae are undoubtedly *Erichthi* by the fact that the carapace covers *all* the thoracic segments, and because the *outer* spine of the ventral prolongation of the uropoda is longer than the inner.

Among *Erichthi* they are distinguished as *Gonerichthi*, by reason of the shallowness and comparative narrowness of the carapace, and by the presence of the small spine on the carapace below the origin of the posterolaterals. These two characters distinguish them from *Lysioerichthi*, while from *Pseuderichthi* they are distinguished by more robust form and by the relatively much shorter outer spine to the ventral prolongation of the uropoda. I have not identified this form with any previously described one as yet, nor am I able to conjecture as to which species of adult it belongs. In the meantime it seems worth while to place on record the regular occurrence of these interesting forms in British waters.

VI.—ENTEROPNEUSTA FROM THE WEST COAST OF IRELAND.

BY

W. M. Tattersall, B.Sc.

Since Bourne (Jour. Mar. Biol. Assoc., Vol. I., n. s., 1889) first recorded the Tornaria larva, the typical free-swimming larva of the Enteropneusta, from British waters near Plymouth, several further records of its capture have appeared. The species recorded by Bourne was *Tornaria Krohnii* (Bourne), and the same species has since been taken off Valencia by Browne (Proc. Roy. Irish Acad., ser. 3, Vol. 5, No. 5, 1900) Mr. Holt tells me that Tornaria are frequently met with at St. Andrews, and they are also known from Port Erin. Mr. Farran has likewise found them in tow-nets taken off County Galway, Ireland. Up till recently, all efforts to find the adult *Balanoglossus* within the sacred confines of our area have signally failed. It is true that a species of this genus, *B. salmoneus*, occurs in the Channel Islands, but that, zoologically speaking, is France.

However, in 1900, Mr. Holt, digging in sand in Bofin Harbour, an island off the entrance to Ballynakill Harbour, County Galway, obtained the posterior end only of a large *Balanoglossus*, which may be *B. salmoneus*, but the absence of its head precludes a definite settlement of this point.

In April, 1903, Mr. Farran discovered the small Enteropneust, *Dolichoglossus ruber*, described below. A single specimen occurred in a dredging taken off Coastguard Point, Ballynakill Harbour (see this Report, 1901, chart of Ballynakill Harbour).

Digging in sand near the same spot, at extreme low water spring tides, in January of this year, resulted in the discovery of several more individuals of this species.

The specimens were first submitted to Mr. Punnett, who declared the species to be new to science. He also very kindly sent me some notes on the internal anatomy, and I am very greatly indebted to him for them and for valuable help.

A preliminary notice of this species was read before the British Association at Cambridge in August of this year, in which the name *Dolichoglossus ruber* was given to it. A fuller description with figures will appear in a future number of this Report.

Habitat.—The specimens were dug out of a mixture of coarse sand and mud, which was capable of retaining a certain amount of water when uncovered by the tide. Similar ground but dry when uncovered yielded no specimens at all. They were found at depths ranging from six inches to a foot, in company with *Solen*, *Mya*, *Echinocardium cordatum*, *Synapta digitata*, *Arenicola*, and several other species of Polychaeta.

When found, the animal was enveloped in a tube formed of sand cemented together by the mucus which it secreted rather freely. The

creature is extremely fragile and readily falls to pieces on handling, so it will be seen that this tube must be of the very greatest service and protection to it. No smell of potassium cyanide could be detected when the specimens were fresh.

Size.—No whole specimens were obtained in spite of the very greatest care taken while collecting. The largest portion of one found, and which appeared to be very nearly whole, measured 12·5 cm.

Colour.—The prevailing colour, as the specific name indicates, is red, varying in intensity and shade, and occasionally absent altogether. The proboscis is rosy red, paler at the tip and deeping towards the collar. The latter is a brilliant scarlet, while the trunk ranges from ruddy brown in the branchial region, through light brown in the genital region, to deep brown, spotted with light lilac, in the hepatic region. Occasionally specimens with a colourless proboscis, and a prevailing tint of pale orange on the trunk and collar, are taken.

External anatomy.—The proboscis is capable of very great attenuation and contraction, and may be as little as twice or as great as eight times the length of the collar. There is a shallow groove along the posterior third of the dorsal surface, reaching to the collar.

The collar is about one and a-half to two times as long as broad, with a slightly thickened rim both anteriorly and posteriorly. When contracted its surface becomes very strongly corrugated.

The branchial region of the trunk is about four times as long as the collar and slightly narrower than the latter. There are from 56 to 64 pairs of branchial openings. The posterior end of the body, as in many other members of the group, is nothing more than a sandbag, and readily drops off when handled.

Internal anatomy.—Mr. Punnett kindly informs me that the relatively great development of the circular muscles of the proboscis, the arrangement of the longitudinal muscles of the same organ, the complete and continuous lumen of the stomochord, and the great size of the pericardium, are all distinctive of this species. Finally, the species possesses two proboscis pores, a feature of great morphological interest, and a point which serves to distinguish it from the remainder of the genus except *D. Otagoensis*, described by Benham from New Zealand. The present records are therefore of great interest as being the first of the group for the British Isles. Only one other species of *Dolichoglossus* occurs in Europe, *D. Merechowski*, having been described from the White Sea to the North of Russia. The genus occurs in isolated areas throughout the world, even as far afield as New Zealand.

APPENDIX, No. VIII.

PRELIMINARY REPORT ON EXPERIMENTS IN OYSTER CULTURE ON THE WEST COAST OF IRELAND.

BY

E. W. L. HOLT AND A. B. E. HILLAS, B.A.*

I. INTRODUCTORY.

1.—OBJECTS OF INVESTIGATION.

The work was undertaken as a corollary of experiments designed to demonstrate or disprove the possibility of materially increasing, by artificial collection of spat, the output of native seed oysters suitable for relaying. In a previous communication† one of us has given a general account of the conditions recently obtaining on the natural beds of Ireland, which conditions have by no means improved in the interval, though an exceptional fall of spat is reported at Tralee this year (1904). It suffices to repeat that of the public natural beds capable of producing oysters suitable for relaying, the west coast now possesses only two of any importance, Tralee and Clarenbridge, of which the last season's (1903-1904) output may be estimated at 445,254 and 300,000 respectively. The Kilkieran beds, which are in private hands, produce seed oysters estimated at about 200,000 annually. Crushrua, in Kinvarra Bay, not far from Clarenbridge, produces perhaps 100,000, but as the holders do not sell small oysters, not very many are available for seed purposes. Cork public beds appear to yield nothing in excess of local demand; the Shannon beds, though apparently recovering, are still unimportant; Clew Bay has ceased to be worth notice, and in Blacksod Bay the once prolific beds scarcely repay searching. With the causes which have led to this general decline we are not here concerned, but it may be remarked that for so long as the Fishery Authority was empowered to make by-laws and regulations, but debarred from any direct power to enforce them, it was not to be expected that their ordinances, however wisely framed, would have much effect. The position is changed by the Act which created this Department, who, in regard to some oyster fisheries, have been given power to lock the stable door only after the horse was stolen.

* It is necessary to explain that for the organisation and direction of the experimental work the responsibility is entirely my own, as also for such opinions as are expressed below on questions of public policy. In other respects the report has been drawn up by us in consultation, but Mr. Hillas is to be credited with the abstraction of results in tabular form.—E. W. L. H.

† E. W. L. Holt, "*The Public Oyster Beds of Counties Wicklow and Wexford*," Report for 1901, Pt. II. (1903), Appendix, No. II., p. 4.

In Tralee Bay oyster fishing is limited to the period between 1st November and 10th March, and the by-law provides that only oysters of $2\frac{1}{2}$ inches and upwards may be taken and sold, a provision which has been enforced with considerable success by the Department's bailiff since the season 1902-3.

At Clarenbridge the fishing is limited by by-law to the month of December, and it is not lawful to take or sell oysters of less than 3 inches. Here the fishermen who assemble from all parts of Galway Bay appoint a committee who in turn appoint two bailiffs, and, by the ordinances of the Committee, the month's fishing has in fact during the last few years been reduced to a week's. Nevertheless, with over a hundred boats at work on so small an area during even the limited period specified, the drain upon the bed has certainly been in excess of its powers of recuperation in normal years, since during the last three seasons the output appears to have decreased annually by about 100,000.*

From Tralee and Clarenbridge a large number of the oysters are fit for immediate consumption, and are accordingly sold for this purpose. It follows that the residue is so small as to afford no opportunity for extensive enterprise in relaying with western native seed, and on this account we have sought to ascertain the relative value for west coast purposes of whatever stock was on the market. It must be remembered that the west coast native is not to be compared with the English Whitstable native. Our western sea-board offers no such conditions of temperature nor of rich feeding induced by the drainage of rivers running through populous and highly-cultivated fertile lands as are afforded by the Thames estuary and its neighbourhood. Consequently the west coast native invites attention for its flavour and absolute immunity from risk of pollution rather than from a bulk comparable to that of oysters which have been grown in more heavily fertilised media.

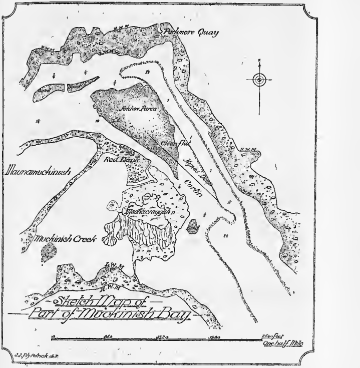
ii.—Locality of Experiments.

The work of which we at present attempt to tabulate the results was carried out in Muckinish Bay, an arm of the sea which joins Galway Bay a little to the east of Ballyvaughan. The lower part of the bay is rather narrow, with so steep a declivity that only the last two-thirds of the flood tide enter the broader part, which is marked upon maps as Poolnaclough Bay, and may once have been known by that name. Higher up the bay commences to narrow again, and is called Poldoody, and the most remote part is a narrow creek called New Harbour. In general direction the bay runs northerly from its head to Illaunamuckinish promontory, where it turns westerly towards the sea. The formation is limestone, and no streams of the ordinary kind enter the bay, but at Poldoody on either side of a small promontory two subterranean springs are constantly running. One of these wells up in a deep hole below low-water mark. The other comes from the foot of a clay cliff at about the level of high-water, and both vary considerably in the amount of fresh water which they discharge.

Oyster culture in Muckinish is of immemorial usage. The Poldoody bed, opposite the streams mentioned, enjoys considerable reputation, though not now much used except for private consumption. In the broader part of the bay below is one of the famous "Red Banks" of County Clare. Here the channel from Galway Bay divides to enclose a large bank, roughly comparable in shape to a leg of mutton, the broadest end being nearest the sea. Only the seaward end of this bank is ever actually dry, but at low water of spring tides there are not more than a few feet of water on any part of it, and one can cross in wading boots

* For this opinion I am responsible. The Clarenbridge returns are not separately enumerated by the statistical officer.—E. W. L. H.

to the southern, or Muckinish, shore on the one hand, or wade far to the southward on either side of the old mearing wall, shown by a line on the sketch map.



The actual "Traroe" or Red Bank seems to have been on the Muckinish side of the southern channel at the mouth of the creek which runs up at the castle of Shan Muckinish, but the name has extended, for purposes of oyster culture, to the central bank. On and about the latter it would appear that there was once a considerable natural bed, extinguished, as one may suppose, by over-fishing in the fifties or sixties, when west coast natives had to fill the gaps created by depletion of sources of supply nearer to the market. Since then the bank has enjoyed considerable reputation as a relaying bed, but in the years immediately precedent to 1900 seems to have been but lightly stocked. In this year it was taken over by a company, from whom the Department obtained the right of carrying out experiments on certain defined parts. The operations were carried out by the servants of the company acting under our directions. We made frequent visits, and were constantly in correspondence with the gentleman appointed by the company to supervise our work.

Though, as is always the case in long narrow inlets opening into the head of a bay, tide is here so much affected by wind that there is no constant of spring tide levels, the broad upper part of the bank is more or less dry at every spring, and covered only by a few inches at neaps. The

soil is a débris of "coral" (Lithothamnion) mixed with sand, shells, and fine limestone gravel, overlying a deposit of coarser gravel. From this part the bank very gradually shelves downwards in the direction of the head of the bay through a section of more sandy ground, which only occasionally dries completely, to a long tapering tail (of the same consistency as the upper part) which is never dry, but is usually accessible by wading at spring tides. The flood tide runs with great swiftness, and by reason of the levels first approaches the upper end of the bank and the eastern side of the tail obliquely from the south or south-west direction. After the first hour or so (third hour of true tide in Galway Bay) the flood runs generally upwards. There is, therefore, in ebb and in early flood a considerable eddy at the broad north-western end of the bank, while the part about the ordinary level of low water springs at the southern end ("Clean Flat") is less subject than the rest to violent tide action.

We have seen that the bank is defined by two channels, of which the western, mnch the smaller of the two, divides the tail of the bank from the mouth of Muckinish Creek, where is a small island called Illaunacraggah, divided at low tide only by a trickle of water from the original Traroe, which is merely a continuation of the southern foreshore of Illaunamuckinish peninsula, and is now, whatever it may have been in the past, chiefly sand. Muckinish Bay is soft mud, and of no interest for oyster culture; but the channel-wards foreshore of Illaunacraggah is much like the tail of the median bank, but somewhat more muddy.

On the Burren side of the bay, opposite the lower end of the bank, is Parkmore Quay, situate in the shelter of a reef of limestone. Some distance above this (reckoning from seawards) is a promontory of boulders, and the effect is that, while the flood or ebb runs true along the side of the central bank, there is always an eddy above the quay. Alongside the quay is a deposit of mud, usually foul with seaweed detritus, but just above it the bottom is fairly clean shelly gravel and sand, with a little mud.

Our experimental layings were made for the most part along the eastern part of the tail of the central bank, covered, as we have seen, at all stages of all tides, but accessible to hand work at low-water springs. This place is marked "Hynes' Deep" in the sketch map, and is so referred to in our tables. We also made a number of layings at the lower end of the bank, on which we constructed a number of "parcs," the walls being made of stones, staunched as well as might be by the local sand. Clay for the purpose was not obtainable, and in effect we succeeded in keeping a practically constant covering of water over the parcs. It is, however, necessary to insist that the making of "parcs" on a bed over which runs a strong tide is an operation that should be prosecuted with the greatest care, since we have been able to discover no known guide to the prevention of a parc wall from becoming synonymous with a sand-groin. Even at Arcachon, where, if anywhere, the art of making parcs is understood, one of us has witnessed the laborious operation of the removal of many tons of undesired sand from a laying. As it happened, only one of our parcs, a comparatively small one, was utterly ruined by sand, but by the extra strength of current induced by the fall of the flood over parc walls a number of small layings were so mixed up that they had to be written off from the results of our experiments.

The system of "parquage" presents the greatest possible convenience to relayers, but it is absolutely essential that those who attempt to deal with oysters in this way should be prepared and equipped to immediately remedy the results of "sanding," a contingency probable if not inevitable in most places suitable for culture in parcs.

Apart from the closure of several experiments in the parcs by sanding or drift, there did not appear to be any very great difference in the results in the parcs at the upper end of the bank and on the natural layings at the lower tail of the bank, but when, as in the case of the Aurays, mentioned in Table XIA, such a difference could be observed, it was in favour of ground naturally under water. Differences in nature of bottom were not observable, while differences of salinity were *nil*, and those of temperature were confined to the period of low-water springs, when, in summer, the temperature of the parcs was usually a little higher than that of the

naturally submerged layings. Oysters of the same quality, laid in both places, appeared in general to attain similar conditions.

In honour of its ancient reputation some layings were made on the Traroe, but a dispute about the ownership of this place caused us to remove them elsewhere.

At Illaunacraggah we made some layings, but, after the first raising, abandoned the site as unsuitable, on account of the strength of current, for small oysters ; while some of our layings of larger stock were confused by the accidental removal of the posts by which they were defined. Subsequently we used part of the same ground for caisses and check ground layings, with better results.

Having acquired some knowledge of the local difficulty of dealing with stock laid in parts of the bay only accessible by dredging we made the layings mentioned above only in places which, though always covered either naturally or by means of parcs, would allow of the oysters being gathered at low-water springs by hand picking or by raking. This system may possibly be condemned as unnatural,* but we had the opportunity of knowing the results of layings in the deeper part of the bed, and of comparing stock from our own layings with stock from the deeper part. The result of the comparison was not adverse to our system, either as regards loss or in respect of condition and growth of stock, though as the greatest strength of the current seems to set across the tail of the bank ("Hynes' Deep") into the north channel we may have lost a good many oysters by drifting in that direction.

The convenience to relayers of being able to raise their stock with the minimum of labour seemed a most important matter, and accordingly, in the second year, we tried some layings along the shore south of Parkmore quay, which is always accessible at low water without the trouble entailed by rowing across the north channel. The results, as will be seen, were found, on the whole, less favourable to growth than on the tide-swept bank.

We did not carry out any work comparable to the system of "wintering" adopted by many cultivators in England. In its fullest extent this system involves the removal of the stock, after the summer growth period, from the fattening grounds on the east coast to storage pits on the south coast, with a view to minimising the effects of a cold winter. On the west coast of Ireland the winters are, in temperature, so mild as to render this unnecessary, in fact no warmer place could be found. In simpler form "wintering" may consist in storing the oysters (during winter) in artificial ponds adjoining the beds, where they are not affected by storms, but are, as we may suppose, rather more subject to the attacks of frost than if left on beds which are always covered by water. So far as we can judge our stock was in no way injured by the neglect of this precaution.

The Marine Laboratory being stationed in Fahy Bay in Ballynakill Harbour, where oyster culture was once carried on to a considerable extent, it appeared desirable to try some layings for comparison with those in Muckinish Bay. Some small layings were accordingly made on the foreshore of Fahy Bay in 1902, and in 1903 work was carried on on a rather more extensive scale.

The bay, which will be found marked on the map following p. 98, has a bottom in the central part of soft muddy sand. The head or western end of the bay is occupied by a broad stretch of hard sand bounded at either end by patches of rather muddy gravel, through which small streams drain the neighbouring bogs. The north side has a foreshore of gravel, mixed with a good deal of "coral" (Lithothamnion) detritus, and the south shore is of much the same character. The mouth of the bay is separated from the channel by a bar of sand and "coral," much of which is dry or awash at the lowest springs of the year. There is a cultivated bed on the opposite side of the channel, and the remains of a public bed once fairly productive. A few wild oysters occur on the bar and on the

* The famous English fattening beds are, we believe, mostly inaccessible except by dredging, and in Zealand Hoek (*Rapport over de oorzaken van den achteruitgang in hoedanigheid van de Zeeuwsche oester*, 1902, cap. iv.), seems to have obtained the best results on the deepest plots which he used.

north and south shores of the bay, but mostly about the south west corner. Our operations were confined chiefly to the embouchures of the two streams, of which the southern is always sheltered from any serious wave action, while the northern is only in danger from violent south-easterly winds. These, however, proved during the period of our experiments quite unusually prevalent, while in 1903 the rainfall was so exceptional as to have some considerable effect on the normal salinity of the bay, and to have caused some disturbance to the layings at the mouths of the streams.

A combination of circumstances have rendered it difficult to institute an exact comparison between the results of layings at Muckinish and Fahy, but these results, such as they are, are set forth in the tables below.

The proper supervision of the work of Muckinish, a most inaccessible place, was found to present great difficulty, while the policy of carrying out experiments through the agency of persons not directly under the control of the Department appeared less truly economical than was anticipated. Therefore, when an opportunity occurred of acquiring direct control of a site at Ardfry, at the head of Galway Bay, which presented equal facility for relaying and greater probability of success in spatting work, it was decided to transfer all our operations to that place. Our stock was therefore moved from Muckinish to Ardfry in the autumn of 1903, and from Ballynakill early in 1904. Save that much of the re-sizing and weighing of 1903 stock was carried out at Ardfry immediately after transfer, considerations of this place do not enter into the present report.

iii.—Methods of Culture.

In the first year's work culture was practically limited to layings on the ground, the sites chosen being such as were covered at all stages of tide, but accessible by wading at very low spring tides. The reasons for the choice of such sites, in preference to deep-water grounds, have already been referred to, but it must be noted that in part selection was made with a view to spatting, and for this purpose layings were not confined to those places which appeared the most suitable for culture. It was also desired to test by results sites which appeared of somewhat different capabilities for fattening.

The ground chosen was divided into sections by stakes driven in at the angles of each section, and layings were separated by an interval supposed to be sufficient to avoid admixture by drift.* The local drift being approximately at right angles to the axis of the principal line of sections no confusion was actually caused in them, but events showed that where there is any considerable tide the migrations of an oyster are hard to estimate. For instance, several Portuguese oysters appear in a year to have travelled about a quarter of a mile from the place where they were laid, and it is impossible for us to conjecture how much of the losses shown in our tables of ground layings may be due to actual mortality and how much to oysters having been drifted away from where they were laid to areas beyond our sphere of influence. Practically it matters not a whit to the relayer whether his oyster has died or wandered, if he cannot lay hands on it when he wants it, for oysters must be exceedingly plentiful and valuable before it will pay to hunt them up by promiscuous dredging.

The layings were made at not more than fifty oysters to the square yard, in accordance with the advice received by one of us when visiting the principal centres of oyster culture in France during the previous year. If directions to this effect were occasionally neglected the excess number was never important, and since the neighbouring ground was by no means heavily stocked there can have been no danger of such overcrowding as we shall have occasion to notice later.

* The chief danger of confusion arose from carelessness in raking at the edges of the layings.

A few small parcs were made at the part of the bank marked "Arklow," and a small number of the smallest French oysters imported were placed in "caisses." More extensive caisse work was not undertaken during this year on account of repeated assurances from cultivators at different places in France that caisses could not be used with advantage except for the protection of spat until they were too thick-shelled to be in danger from crabs. Mr. J. T. Cunningham, however, who had made some experiments with caisses at Falmouth,* informed us that he found that large oysters reared in caisses were not apparently inferior to those from ground-layings, and in view of our very heavy losses on the ground we decided in the second year to give the caisse system an extensive trial, both for large and small oysters.

In regard to the small French oysters from Auray and Arcachon, the importations made in the second year were of the same trade qualities as those of the first, but no control ground-layings were made, owing to an oversight on the part of the officer responsible, so that the comparison of ground and caisse results dealt with below is to some extent vitiated by the difference in the weather conditions of the two years as well as by a slight difference in the character of the lots received in each year. Other oysters dealt with in caisses are comparable with ground layings made at the same time.

The "caisse ostréophile" is a shallow tray with wooden sides and wire-netting bottom. Those which we used differ in dimensions from the French originals only in the differences of the metrical system. They measure $6' \times 3'$, and are divided into three equal compartments of $2' \times 3'$. The sides and partitions are from $4''$ to $2\frac{1}{2}''$ high, the difference proving immaterial except in uncovered caisses in very exposed situations. The corners are strengthened internally by cross-pieces at the angles, all material being $1''$ or $2''$ thick, unplaned spruce. The bottom is made of galvanised wire netting, preferably of not more than $\frac{1}{2}''$ mesh and of as thick wire as can be obtained. A caisse of these dimensions, $1''$ wood, and wire-netting bottom, costs, with materials and labour, about 4s. Wire netting will not take tar properly, and wears out in a year or less. The wooden frame, untarred, seems to be good for at least three years, unless attacked by the boring isopod *Limnoria*, generally known in Ireland as "worm," and in England as "gribble."

If made of stout wood, with square-mesh woven wire bottom of 16 gauge, and tarred every year a caisse seems to be practically indestructible, some of this description having been in use, as we are informed, for thirty years.

In France the caisses are supported on flat-topped stakes projecting a few inches above the ground. They are secured by flat staves driven into the ground, two on each side or two at each corner, secured by a big nail which passes through stave and nearest part of caisse, but so loosely as to be easily pulled out with a claw hammer. Usually each caisse is covered by a similar caisse inverted, similarly secured to the staves, but at Auray the covers are sometimes merely rough frames of boards, weighted down by stones. The object of the cover is, of course, to keep out the crabs, which are a danger to small oysters, our information being to the effect that an oyster is not crab-proof until it measures two inches across the shell. The crab in question is the common shore-crab, *Carcinus maenas*, and in this country we have some reason to think that in the case of thin-shelled French seed its enterprise is not limited to two-inch shells, though, since in France full-sized shore-crabs have a comestible repute and none with us, large specimens are more abundant here. The caisses and covers, when of $\frac{1}{2}''$ mesh, also serve to keep out the "borer," *Murex erinaceus*, a knobby whelk-like mollusc most destructive of small oysters, and star-fish are similarly excluded.

For caisses of small oysters we used covers of one sort or another, but did not succeed in finding anything more serviceable than the inverted caisse. For large oysters a cover was at first considered unnecessary, and in sheltered waters was not found to be needed; but wherever a caisse was

* See Reports of Cornwall County Council, Fisheries, 1897–1901.

exposed to wave action at low-water we had ultimately to provide covers, because the oysters got washed out of the caisses. Even when covered, oysters so exposed got packed together at one end of the compartment and had to be spread out again when the caisses were visited, as is desirable* at every spring tide. It may seem that this is a process involving inordinate trouble, but on the whole it is really less onerous than the proper care of a laying; for the proposition that oysters can be laid on a bed and left alone until required for market will, if carried into effect, be more productive of experience than of profit.

Apart from preventing loss the covers seem to us to have another advantage in providing shade from heat or cold when the caisses are exposed at unusually low spring tides. Algae of various kinds grow rapidly on the covers, and, besides providing a rich store of food in the diatoms which infest them, are an efficient protection from either heat or cold when the caisses dry. Theoretically caisses should be put where they are just awash at low springs, but the level of the latter is in many places so inconstant that it is usually necessary to place them somewhat higher up the shore.

Using inch wood and ordinary wire netting we suppose that the cost of culture may be increased by the use of caisses by about 1s. per 1,000 oysters, or about 2s. if the caisses are covered. If the caisses are made of strong scantling and woven wire, and tarred, the annual cost is no doubt reduced, but we are not yet in a position to give figures on this point. Our tables show that the caisse system was found at least as effective in growth as ground-culture, and much more effective in reducing losses. Its practical utility must, however, depend on the degree to which it is possible to crowd the oysters in the caisses without impairing the growth, and on this point our tables, which recite the number of oysters laid in each compartment, offer some evidence of a preliminary nature. It is to be noted that the caisses were scattered sparsely over a large area, thus increasing the time occupied in attention to them, and it is not to be assumed that ten caisses packed in an area of sixty by thirty feet will yield a result as favourable as ten caisses per acre. Indeed, from our later work at Ardfry, not yet in condition for publication of results, we think we have some evidence that overcrowding of caisses may mean starvation to their inmates.

Except for this remark we do not propose to deal at present with the important question of food, which will be the subject of a later communication.

In addition to the more extensive use of caisses in the second year of our work at Muckinish, we considerably extended the parcs at "Arklow," enclosing an area amounting altogether to about 3,000 square yards. Our experience here may be said to have served to demonstrate that unless one is prepared, as in France, to immediately combat the encroachments of sand, the parquage system is not to be attempted where such encroachments are likely to occur. Owing to the circumstances under which our work was carried out, we were not in such a position, and incurred some losses which cannot really be blamed against the system.

iv.—Measuring and Weighing.

iva —*Measurement.*

Several methods are employed for dividing oysters into different grades. They may be simply quoted by weight per thousand, or divided roughly into size grades of which the dimensions are not stated, and are often estimated by eye alone.

* Where small oysters are concerned it is absolutely necessary, but some caisses containing big oysters were left practically uncared for a season without apparently prejudicial results. It seems quite possible that caisses which, from their situation, or by the provision of covers, are immune from the danger of becoming choked with putrefying seaweed, or of having their contents heaped together at one end, may be left alone without prejudice or even with advantage to the oysters in them. This question is at present the subject of further experiment.

Gauges, where employed, may be in the form of rings, and in this country, for purposes of by-laws in connection with under-sized oysters, the measurement is interpreted as the greatest diameter of the oyster in any direction. Thus if the oyster can be induced by any manipulation to present a dimension as great as or greater than that of the diameter of the ring-gauge it passes muster.

At Auray, while the spat on removal from the "collecteurs" is graded by means of sieves of metal with round perforations, larger sizes are measured by means of a wooden gauge. As this latter method was adopted in our experiments it may be well to describe the process in detail.

The gauge consists of a piece of wood, preferably of some hard kind, and may conveniently be about 12″ long by 3″ deep and ½″ thick. Spaces of the required sizes are cut in the edge of the gauge to the depth of about ¾″; from three to four of such spaces, according to length of each, can be cut in each gauge.

The oyster is held with the flat shell undermost or next to the gauge, and, its hinge lying in the middle of the space in which it is being tried, it is then drawn towards the operator and classed according to the size of the greatest space through which it will not pass.

At times it may be necessary to try the oyster successively in several size-spaces, but as a rule a practised eye will select the right space at once.

In the illustration below are shown two oysters. No. 1 is of irregular growth, while No. 2 is fairly regular. In both the line AB passes through the dorso-ventral diameter of the oyster and is cut by the line CD drawn at right angles to it through the greatest breadth of shell.

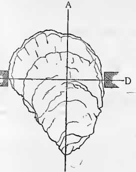


Fig. 1.

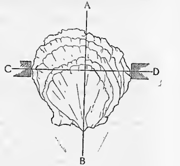


Fig. 2.

The size of the oyster is determined by the measurement of the space between the points C. and D. In oysters of very irregular growth it is sometimes impossible to find a line CD expressing the greatest width, and in such cases the width must be estimated as between lines parallel to AB and touching the front and hind edges of the shell respectively, but this does not occur often.

Of any method of measurement which could be carried out in reasonable time when dealing with large numbers, this seems to us to afford the most constant basis for comparison of growth. It is subject, of course, to variation of result by differences in the shape of individual oysters and to some variation according to the perfection or abrasion of their new growth at the edges of the shell. We think, however, that variation from these causes is less in the case of the dimension so measured than in any other dimension which could be chosen.

Oysters can be classified in this way in any series of gradations, it being merely a question of cutting spaces with larger or smaller differences of

size. In our experiments we adopted half-inch grades, and in dealing with large numbers experience suggests that no finer gradation is practicable.

There must, of course, be considerable scope in the size of oysters classed by gauge in two successive half-inch lots. Thus an oyster of just two inches will fall into the 2″ grade, while an oyster just under three inches will be classed as 2½″, though one is nearly an inch wider than the other.

We are doubtful whether in the case of the earliest lots handled at Burren, sufficient attention was paid to drawing the oyster straight through the gauge, and in some cases it would appear that the measurement of AB was registered instead of CD. The latter process would often place the oyster in a higher grade than that to which it really belonged, and is probably the reason why a number of oysters appear, when raised, as 2″ and 2½″, though laid as 3″.

Discrepancy of this sort is particularly noticeable in the results of the raising of the first consignment of Tralees (see Table I.). However, it may be noted here that in this laying small oysters were not always detached from the shells of the larger ones, and, having got loose before raising, may account for some of the small ones.

Another source of discrepancy, but not a large one, undoubtedly arises from the thin growth at the shell edges having been chipped off after measuring.

In general, measurements of dimension are of more value for comparison of oysters of the same class than for comparison of oysters derived from different sources, and in all cases consideration must also be paid to weight. For instance, an Auray oyster of 2″ and a Burnham of the same size have nothing in common but the gauge measurement.

ivb.—*Weighing and Examination of Samples.*

The various consignments on arrival at Burren were immediately placed in water, and an interval of at least twenty-four hours elapsed before they were handled for sizing and weighing. The oysters had thus time to take in the normal amount of water, but no special precautions were taken, as by Hoek, to keep them shut. Dr. Hoek's memoir* did not come into our hands until the observations had been continued for such a period that an alteration in procedure seemed inadvisable, since to make our later observations exactly comparable with his would have entailed some serious discontinuity of method.

Our method of examination was as follows:—

The oysters having been sized, as above, a sample was taken, without selection, from each half-inch size. The sample was brushed clean, any spat or attached growths being removed,† and weighed. The shells, after the time occupied in measuring and by the process of brushing, were externally dry to a practically constant degree, and the amount of water in the shell, the samples being fairly large, may be taken as reasonably constant. When only a small sample, twenty or less, of a half-inch size was available we have not attached much importance to the result, but consider that the water in shell is less a factor of unreliability than is the individual variation in the bulk of oysters which fall into the same half-inch grade.

From the larger samples of which gross weight was taken, fifty, or whatever less number was available, were opened on the deep shell, both ends of the adductor muscle being cut from the shells. The oysters were left in the deep shell with any liquor that had not been spilled, and were classed by eye into degrees of fatness. This operation is naturally affected by the personal equation, but is probably sufficiently constant for practical purposes. The classes are "very fat," "fat," "moderate," "thin," and

* *Op. cit.*

† We imagine that calcareous worm tubes (*Serpula*) and barnacles (*Balanus*) may not always have been efficiently cleaned off, but they are not common enough at Burren to have affected the results.

"very thin," the standard being an eye appreciation of the best class of Burren oyster. Such an oyster does not commonly attain the same degree of fatness as a Whitstable "native," but is recognised as excellent of its kind. The chief difficulty arose in determining the "moderate," but most of those so entered would probably satisfy a not too exacting customer. Immediately after classing, the liquor was drained off from the deep shells and the fish transferred to a saucer and weighed. It was always found that a certain amount of liquor was apparent in the saucer, but this was not removed, as being in the main derived from the oyster itself. In Hoek's experiments the fish was superficially dried with blotting paper after being loosened from the shell (P. P. C. H. *in litt.*), but if this had been done without greater skill in opening than we could command, we think the true weight of the oyster would have been reduced.

We did not weigh the shells separately, but this has been done since Hoek's methods have been communicated to us.

Dealing with large numbers with, usually, only one observer to make record, examination in greater detail did not seem possible, and our results are at least comparable *inter se*.

The numbers from which the original average weights of the oysters on arrival were taken are stated in the tables; or, when not stated, the number was 100 for gross weight and 50 for fish weight, unless the total did not reach 100, when the whole number was weighed.

At stock-taking, 1902, the average gross weights were taken from samples of 200, or from the nearest even number if the total was less than 200. The fish weights were taken generally from samples of 50, exceptions being shown in the tables.

At stock-taking, 1903, the average gross weights were taken from the whole number available at each half-inch size, and the sample examined was re-weighed for gross weight. The average gross weight of the sample, when found to differ by 5 grm. or more from the average of the main bulk, is indicated in the tables by a footnote.

V.—Varieties of Oysters used in the Experiments.

IRISH NATIVES.

Tralees.—These oysters are derived from the public beds in Tralee Bay, which extend along the north shore from Spa to the neighbourhood of Fenit and across the bay to Derrymore. They are mostly worked by the dredge, but at low spring tides a number may be picked up along the shore.

The beds, having apparently greatly deteriorated in previous years, appear to have not been very heavily worked in the years immediately precedent to 1900. In the 1899-1900 season the stock was abundant, and to the knowledge of one of us, there was a fair fall of spat in 1900, but the bed was not much known as a source of supply, and the price during part of the year was as low as 10*d.* per 126. A large number of oysters dredged during this season could not be sold, and seem to have been thrown into a dry ditch at Spa instead of being returned to the beds. The season for dredging is from 1st November to 10th March, and the close season seems to have been generally observed, but no great attention was paid to the by-law defining the size ($2\frac{1}{2}''$) at which oysters might be removed from the beds. Enforcement of the by-law was limited to occasional action by the Royal Irish Constabulary, who have many other duties to perform.

The local interpretation of the size-limit, in so far as attention was paid to it, was to the effect that any oyster which, by virtue of its own dimensions or by adhesion to others of its kind or to any foreign substance, could be induced to stick in a $2\frac{1}{2}''$ ring, might be considered as fulfilling the requirements of the by-law, and it does not appear to have occurred to the fishermen that the removal and return of small oysters would have been to their own interest.

The purchases which we made in the season of 1901-2 efficiently demonstrated the inadequacy of local regard to the by-law, and the immense waste involved by exportation, at no increase of price, of small oysters (attached to the larger ones) which might have been returned to the beds. The Department has since appointed a bailiff, who, with the assistance of the local Constabulary, has succeeded in enforcing the by-law and in securing the return to the beds of the small oysters found adhering to those of legally saleable size.

Possibly as a result of information conveyed to relayers by officers of the Department the demand for Tralee oysters increased greatly in the season of 1901-2, and ensured to the fishermen a somewhat higher price, which in subsequent seasons has constantly increased. At present, in the season of 1904-5, it stands at about 3s. per long hundred, but this is with the assurance that any attempt to dispose of oysters of less than 2½″ will entail serious consequences. There has been, we may add, a very fair fall of spat in the summer of 1904, which in due season may compensate for the present rather exhausted state of the beds. A by-law orders the immediate return to the beds of all cultch raised in the dredge, but no idea of attempting by deposition of extra cultch to increase the natural production of the ground appears to have ever entered the minds of the local fishermen. The latter regarded with so much suspicion a proposal made by the Department to attempt to catch spat on artificial collectors that it was decided to abandon the enterprise, and to restrict operations to the attempt to prevent the fishermen from robbing themselves more than is absolutely necessary in the prosecution of the industry. The appearance since about 1899-1900 of oysters in the channel opposite Spa may perhaps be due to dredgers culling out the cultch there when waiting for low water on return from the usual dredging grounds.

The purchases which we made in the season of 1901-2 cost us from 15s. to 17s. 6d. per long thousand (1,260) and, being in the main designed to increase the breeding stock on the Burren beds, were only handled to the extent necessary to separate them into half-inch sizes, an operation which, judging from the results at raising, seems to have been rather carelessly performed (see also p. 224). The first stock-taking, however, sufficiently demonstrates the value of this class of oyster for relaying on a bed of good flavouring and fair fattening qualities, and, for practical purposes, we consider that Tralees may be taken as the standard of oysters for relaying on west coast beds. The supply, unfortunately, even in 1901-2, did not prove equal to the demand, and has since diminished.

Clarenbridges.—These oysters, derived from the public bed in and off Dunbulcan Bay, near Clarenbridge, are of much the same character as the Tralees, but, as taken direct from the bed, the large ones are in somewhat better market condition. The supply has greatly diminished of recent years, and cannot now be reckoned of much importance in large relaying operations. The results of our experiments with this and the preceding variety will be found detailed in the tables and in the section of the text which deals with profit and loss.

Crushruas.—The Crushrua bed, which may apparently be spelled according to individual fancy, is in Kinvarra Bay, an inlet of Galway Bay, opposite a village the name of which is, phonetically, the same, and is effectively held by the villagers as a several fishery. The output appears, as we have already noted, to be about 100,000 annually, and dredging is only carried on during the month of December. The profits are divided according to the rent or purchase instalment of holdings, and no small oysters are removed from the bed. In fact the latter affords an illustration of the favourable result likely to accrue from the vesting of a naturally productive bed in the possession of a peasant community, were it by any means possible to do so.

Since the output is not sufficient to be of much importance to relayers we purchased only a small quantity, which furnished the necessary samples for examination, but did not afford suitable material for presenting the results in tabular form.

In April, 1902, 46 oysters, 3″ by Auray gauge, derived from this source, had an average gross weight of 123 grm., and in 5 of these the fish weight averaged 11·3 grm. Fifty of $2\frac{1}{2}''$ had an average gross weight of 95 grm., and 5 fish averaged 9·4 grm. In July of the same year 50 of the largest in the sample averaged 104 grm. Twenty-five, opened in search of spat, gave an average fish weight of 7·7 grm.

We may say, from observation of these oysters in the hands of relayers, that most of them are fit to be re-sold for immediate consumption when raised from the natural bed, but are capable of improvement by a sojourn on richer ground. Since, however, they are already of large size when sold out of Crushrua, it appears to us that fattening them through a summer and autumn would entail losses disproportionate to the increase in individual value.

Carlingfords.—By reason of the report of the Local Government Board, oysters from Carlingford Lough may have come under suspicion of pollution, which one of us (E. W. L. H.) takes leave to think is somewhat unreasonable in regard to oysters as directly raised from the natural beds of the Lough. The by-laws which restrict the fishing and sale of oysters to a short period in the winter have no doubt given excellent results in the protection of the beds from extermination by over-fishing, but have in a manner placed the fishermen at the mercy of buyers, who by combination may have been able, owing to the shortness of the season, to command sale at whatever price they chose to fix. In self-defence the fishermen have adopted the practice of laying whatever stock they could not sell at a fair price in "rings" on the foreshore near their homes, and in situations not always quite free from risk of pollution. Theoretically, the ringed oysters would be sold during the next open season; practically, as appears from the reports of numerous prosecutions, sales may take place whenever opportunity occurs. That cases of disease may have been accurately traced to the consumption of oysters from some of these foreshore deposits is not impossible, but that any reasonable risk attaches to oysters raised directly from the natural beds appears from the vast volume of the Lough most unlikely.

Be this as it may, a period of quarantine in unpolluted waters, will, no doubt, reassure the consumers. We did not import any oysters from Carlingford, but purchased for examination a sample of 150 which had been relaid at Burren for over a month. One of us was informed at Carlingford that these oysters, if relaid on any other beds, deteriorated. If so, they must be remarkably fine oysters when first raised, for the Burren samples were as good as any man need wish. Fifty of each half-inch size, 3″, $2\frac{1}{2}''$ and 2″, gave average gross weights of 70, 56, and 40 grm. respectively, fish-weights 8·8, 7·6 and 5·8 grm. The 3″ comprised 44 fat, 4 moderate, and 2 thin, the $2\frac{1}{2}''$ 41 fat, 3 moderate, and 6 thin, and the 2″ 41 fat, 7 moderate, and 2 thin. In appearance and flavour they were as good as any sample of oysters relaid on a western bed.

Carlingfords are among the best of Irish natives, and if the cost price, not likely to exceed 5s. per 126, can be bettered by a period of quarantine on beds to which no reasoning being would attach suspicion, they seem worthy the attention of the relayer.

Arklows.—The oysters from the public beds along the coasts of Wicklow and Wexford (except Wexford Harbour) are generally called "Arklows." They have been discussed by one of us at considerable length in the Report for 1901, and since the date of that publication we have heard of no considerable development in the industry, and are not aware to what extent the natural stock has been maintained.

We imported some small consignments to Burren and Ballynakill, and sent some to a cultivator in Ballysodare Bay, with a view to ascertain whether their flavour and general table condition could be improved by relaying. The numbers so dealt with were too small to admit of satisfactory treatment of results in tabular form, but we may say here that the oysters did improve considerably in flavour and condition, but retained in great part the toughness which characterises them when dredged.

They are huge oysters, and in regard to measurement of shell and to weights of fish and shell, are hardly comparable to any of the kinds dealt with in the tables. As dredged they may be roughly divided into two classes of similar measurements, which may be called "young" and "old" respectively. The young are thin and flat in the shell, and owe their size to immunity from abrasion of the shell growth. The old are much heavier in shell and have evidently been exposed by tide and wave action to more or less constant pruning of the new shell growth. Samples dredged in April, 1902, will sufficiently illustrate their condition:—

—.	Size.	Number.	Average Gross Weight.	Number.	Average Fish Weight.
	Inches.		Grm.		Grm.
Old, ...	4½	10	263	5	16·3
"	4	24	235	5	16·6
"	3½	25	185	5	11·6
"	3	10	140	5	7·8
"	2½	8	138	5	7·5
Young, ...	4	3	122	2	9·7
"	3½	7	107	6	8·6
"	3	5	85	5	6·0
"	2½	5	57	5	4·1
"	2	2	34	2	2·9

The number first mentioned is that of each size in the sample and from which the average gross weights were deduced. The second number is that from which the fish weights were taken. The number which we kept under observation was not sufficient to admit of an exact statement of mortality. On the whole Arklows, except the largest, which seem delicate, appear to be normal for Irish natives in this respect, and for consumers who insist on size these oysters may be worth the consideration of relayers, if they can be obtained at a reasonable price. This aspect of the question was noticed in the Report for 1901, so need not occupy us at present.

ENGLISH NATIVES.

Kentish Knock.—These are oysters from the natural beds in the Whitstable district, and are sold as dredged—a mixture of all sizes. In shell they are clean, and a proportion of the larger ones have the appearance of the "Whitstable native" as sold for consumption.

Essex.—We obtained some small consignments from various natural beds on the Essex side of the Thames Estuary, but the results do not appear sufficiently conclusive to be worth giving in tabular form until further experiment has been made. They are small, deep oysters, attaining, in a small but thick shell, a marvellous degree of fatness on their own beds. They did not do well in our caisses at Ballynakill, but the season was far from favourable, and the *locus* apparently unsuitable. Full grown "Burnhams," as will be seen (Table XXX), survived a month's relaying at Ardfry without loss of condition or serious mortality.

Falmouths.—These are treated at length in the section explanatory of the tables, and need not be further noticed here. The "full-grown" Falmouths, sold after being relaid in parts of Falmouth Harbour and its estuaries which are not exposed to serious copper pollution, are for the most part quite free from discolouration, and, the price being low, may be worth attention for turn-over after a period sufficient to eliminate risk of sewage pollution.*

* The risk of course depends upon the part of the Harbour, as to which see 24th Report of L.G.B., England, 1894–5.

DUTCH OYSTERS.

A small consignment, dealt with in the section explanatory of the tables, consisted of oysters quite satisfactory in appearance and shell. The results of relaying were, as will be seen, not very satisfactory, and the comparatively high cost price inclines us to think that Dutch are not of much value for relaying, but it must be noted that there are many kinds of Dutch oyster, and some may be better for relaying in Ireland than others.

FRENCH OYSTERS.

As is well known from the reports of Bashford Dean* and Herdman† in recent years, and from a number of earlier publications‡, the principal French centres of production of seed oysters are Auray and other parts of the Bay of Morbihan in Brittany, and Arcachon, a little south of Bordeaux. From these places, by the perfection of Coste's system of artificial collection of spat, seed oysters may be obtained in practically unlimited numbers. At Arcachon it is prohibited to export oysters of less than 5 cm., about 2″, but at Auray there is no such restriction.

Immense numbers of small stock appear to be annually imported to England, so it may be presumed that the differences in climate are not such as to render the transaction an unprofitable one. The oysters are rather flat in shell, and, size for size, even after relaying, are often deficient in fish weight as compared with Irish natives, but, if a sufficient stock can be brought to maturity, are certainly worth attention.

In this section of the report we may confine ourselves to a discussion of the important question of transport, as to the difficulties of which complaint is from time to time made by importers.

English oysters, whether sent from the mouth of the Thames by rail to Holyhead or Liverpool, and so by sea and rail to Ardrahan, Oranmore or Clifden, or from Falmouth by sea as far as Dublin, and thence by rail to Ardrahan or Oranmore, have always arrived in good condition without the necessity of any precaution beyond that of ensuring their despatch on an early day of the week.

In the longer journey from France it is always necessary or at least advisable to provide against the delay which may arise from the oysters arriving at Dublin on a Saturday too late to be entrained, under ordinary arrangements, on that day, and so being delayed until the following Monday. In such cases we have always found the railway and dock officials most willing to assist us, but of course some extra charges have been incurred, chiefly from the necessity of sending the consignment from Dublin by passenger instead of goods train. When no risk arises of delay on Sunday, we have found it as well to ask the railway authorities to advise us by wire, or telephone, of receipt in Dublin, which they have always been kind enough to do, and in this way we have been able to avoid the possibility of delay in carting the consignments from the western station to the beds. French exporters pack their goods with such consummate skill that in cool weather a day or two more or less probably makes little difference to the well-being of oysters, but if the season is warm or exceptionally cold no precaution can be safely neglected.

The following statements of charges are of practical interest:—

Arcachon Oysters.—Both consignments were purchased from "La Société Immobilière du Moulleau et des Pêcheries de l'Ocean," Arcachon, Gironde, France.

* Bulletin U. S. F. Comm.

† Rep. for 1893, Lancs. S. F. Lab., 1894.

‡ Among these may be cited:—Pennell—Report on the Oyster and Mussel Fisheries of France, Board of Trade, 1868.
Report of Commission, Oyster Culture [C.—224.], 1870.
Hayes—Report on the Principal Oyster Fisheries of France [C.—1984.], 1878.

The first consignment consisted of :—

12,000 first quality, at 14s. 10d. per thousand.
10,000 second quality, at 9s. 6d. ,,

The oysters are graded according to the gross weight, the first quality being from 35 to 36 kilos, and the second from 25 to 28 kilos per thousand.

The expenses incurred in the transit of this consignment were exceptional, as owing to its arrival in Dublin on Sunday, special arrangements had to be made.

The total cost of the carriage, &c., from Bordeaux to Ardrahan was £6 2s. 7d., made up as follows :—

	£	s.	d.
Freight, &c., per direct steamer, Messrs. Hutchinson's French and Peninsular Steam Packets (Messrs. Palgrave, Murphy, and Co., Dublin Agents) from Bordeaux to Dublin, ...	0	19	10
Marine insurance, ...	0	2	6
Sunday cartage in Dublin, ...	0	5	0
Four men landing on Sunday, ...	0	8	0
Customs Officer's time, ...	0	19	0
Railway charges, passenger train to Ardrahan, .	3	8	3

The oysters left Bordeaux on March 17th, and reached Ardrahan on March 24th.

The carriage as shown above brings the prices to approximately 20s. and 15s. per thousand.

A second consignment was ordered in 1903 (of which part was sent to Ballynakill).

The numbers ordered for Burren were :—

5,000 first quality, at 15s. per thousand.
5,000 second quality, at 9s. 6d. ,,

The total cost in carriage, &c., was £1 8s. 6d., made up thus :—

	£	s.	d.
Freight from Bordeaux to Dublin, *via* Liverpool, on twelve boxes (six of which were sent to Burren), £1 4s. 6d., the amount chargeable against Burren being	0	12	3
Cartage in Dublin 1s. 4d., half chargeable to Burren, ...	0	0	8
Railway charges on six boxes to Ardrahan, .	0	15	7

These charges bring the cost of the oysters delivered at Ardrahan to approximately 17s. 6d. and 12s. per thousand.

The oysters left Bordeaux on April 2, and arrived at Ardrahan on April 7.

The losses in transit were very small in both consignments and for practical purposes may be neglected.

Auray Oysters.—The oysters were obtained from D. and C. Jardin, Ostréiculteurs, Auray (Morbihan).

The first consignment was made up of :—

10,000 5—6 centimetres, or 1st grade oysters, at 9s. 6d per thous.
20,000 4—5 centimetres, or 2nd grade oysters, at 6s. 6d. per thous.
40,000 2½—4 centimetres, or 3rd grade oysters, at 4s. 3d. per thous.
All f. o. b. St. Malo.

The total cost of carriage on the above to Ardrahan Station was £5 13s. 1d., viz :—

	£	s.	d.
Freight and shipping charges, St. Malo (Auray) to Dublin, per British & Irish Steampacket Company, including cartage to Broadstone Station, ...	2	19	7
Railway charges to Ardrahan Station, ...	2	13	6

The oysters were despatched from Auray on the evening of December 6, and reached Ardrahan on December 13.

Two smaller consignments were received in 1903, and are referred to in the text and tables as the "2nd consignment."

(1.) 7,000 5—6 centimetres or 1st grade oysters at 9*s.* per thous.
10,000 4—5 centimetres, or 2nd grade oysters, at 6*s.* ,, ,,

The total cost of carriage to Ardrahan Station was £2 13*s.* 8*d.*, viz:—

	£	s.	d.
Freight and shipping charges, St. Malo to Dublin, per British & Irish Steam Packet Company, including cartage to Broadstone, ...	1	12	8
Railway charges (Mail train) to Ardrahan, . . .	1	1	0

The oysters were despatched from St. Malo on March 31st, and arrived in Dublin at midnight of Saturday, April 2. This necessitated additional charges for cartage and special arrangements for transit to Ardrahan.

(2.) 10,000 2½—4 centimetres, or 3rd grade oysters, at 4*s.* 8*d.* per thous.
Total charges on this small consignment amounted to 16*s.* 9*d.*

The oysters left Auray on April 19th, and arrived at Ardrahan on April 25th, having been sent from St. Malo to Southampton, by rail to Holyhead, by North Wall boat to Dublin and rail to Ardrahan.

In addition to the sizes which we used, larger oysters can be obtained at Arcachon, and oysters of all sizes, from spat as removed from the tiles to huge "pieds de cheval," can be had from Brittany, but the price of the larger oysters from both sources varies so much with conditions of supply and demand that no quotations which we could give would probably remain of use for more than a few months. We have had the opportunity of observing some large Brittany oysters relaid for early turnover on a West Coast bed, and can say that they appear to be among the hardiest of which we have knowledge. French oysters, fattened on English beds, are always on the market at moderate prices and may be of interest to proprietors of layings which possess special flavouring qualities.

VI.—Comparison of Physical Conditions of the two years.

In several instances our comparisons of ground and caisse culture depend upon operations made in 1902 and 1903 respectively. It is therefore possible that they may have been to some extent vitiated by differences in the physical conditions of the beds during the two years. It was a part of the duty of the gentleman charged with the local conduct of operations to take constant observations of temperature and specific gravity (by hydrometer) upon the beds. For reasons which, at a distance, we were compelled to regard as sufficient, the continuity of these observations left much to be desired, a circumstance which led us to regard with increased favour the transference of the experiments to the care of a staff under our immediate control.

The records of temperature, derived from the readings of a maximum and minimum thermometer, are naturally fairly complete, in that the extremes between readings were automatically recorded. It is not possible to state actual means for the respective months, but the following notes are sufficient for practical purposes. The readings mentioned are averages, as far as they are deducible, between successive observations.

In January, 1902, the mean is probably not far from that of the same month in 1903, but in the first year the range is from 5° to 8·5°C., and in the second from 5·5° to 7·5°.

In February, the 1902 temperature was generally lower, ranging between 5° to 7·5°, while that of 1903 lay between 6° to 9·5°, the month in both years ending at about 7·5°.

In March the temperature, between 7·5° and 9·5° in 1902, was generally higher than in 1903, 6·5° to 9·5°, while in both years the month ended near 9°.

In April the first half of the month was certainly warmer in 1903, reaching to near 12·5°, the mean in 1902 not exceeding about 9°, but the second half did not greatly differ in the two years, though about a degree warmer (12°) in 1903 at the close.
May in 1903 was probably generally warmer than in 1902, and distinctly so at the close, viz., as 16° to 14°.
June in 1903 was distinctly warmer than in 1902 except at the end, the months closing respectively at 15° and 17°.
In July over 20° was reached in 1903, and not quite 18° in 1902, but the means were probably not greatly different, and the month closed in both years at about 16°.
In August the differences do not appear to have been of importance, the mean in both years being near 16°.
After this month it is not possible to compare the temperature in the two years, since the staff was occupied in 1903 in collecting the stock for transference to Ardfry.
In September, 1902, the mean may have been about 15°, with a sudden fall at the end of the first two weeks and considerable fluctuation later.
In October, 1902, the mean was about 12°, the principal fall being at the beginning of the month.
In November, 1902, the fall is fairly continuous, the mean appearing to be near 10°.
In December, 1902, there was at first a sharp fall to 6°, followed by a rise to 10°, the last observation being below 6°.

The records of specific gravity are in both years lamentably meagre, except in July to September, 1902. It would appear, however, that in January the specific gravity fell much lower in 1902 than in 1903, the minimum observed being 1·012 as against 1·021, but the fluctuations in the bay are so sudden that discontinuity of observations may entirely invalidate them. In March and April it was probably generally lower in 1903 than in 1902, in May and June there is no evidence of important differences. In July, August, and September, 1902, it remained constant between about 1·026 and 1·027. Throughout most of October, 1902, it accorded with the observations of the previous month, but showed considerable fluctuation in November, and in December ranged between 1·012 and 1·024.

Observations of rainfall were kept, but cannot be relied on to check the records of specific gravity, since the principal source of change in this respect is not, we think, the local rain, but the draining of up-country districts through the springs of Poldoody.*

On the whole we think there is nothing in the differences of temperature of the two years to account for any important differences in the condition of stock, while the records of the specific gravity are insufficient for comparison. Judged from the evidence of condition of oysters, 1902 was certainly not inferior to 1903, and we think it perfectly safe to assume that where in 1903 we have been able to demonstrate a better result in caisse-culture than was obtained by ground culture in 1902, such difference owes nothing to the existence of more favourable conditions in the later year.

VII.—Mortality and Loss.

It is the duty of one of us, when information is sought by persons proposing to embark upon or extend the cultivation of oysters, to advise as to the conduct of the work and the prospective return. While the general question, complicated by difference of local conditions, is very far from easy for the adviser, perhaps the most serious difficulty arises in an even approximately correct estimate of the losses of stock, and the causes contributory thereto. There are not, that we have been able to discover, any published records from which, even in regard to particular localities,

* Owing to the limestone formation there are in South Galway and North Clare many streams which disappear underground, and springs at or below sea level are not rare.

it is possible to deduce correct returns of losses. Enquiries addressed to cultivators of great experience have always received most courteous treatment, but in effect accurate knowledge of loss appears to be confined to layings or pits of market stock placed between tidemarks or in artificial enclosures. Under these conditions the losses seem to vary enormously, in fact from 0 to 100 per cent.* Such layings or stores are held chiefly during the winter months when frost may destroy them altogether, or, since they are often in estuaries, abnormal mortality may be attributed, as in the winter of 1903-4, to excess of fresh water. To what degree the latter explanation may be correct it is certainly not apparent, nor do we know of exact observations (or any at all) of the degree of reduction of salinity which, if continued for some time, has fatal effects. For our purpose a knowledge of the losses which may be expected before the oysters reach market condition is of more importance, and here the difficulty of obtaining exact information arises from the fact that the earlier stages in British and Irish systems of culture are as a rule in part or entirely passed on beds accessible only to the dredge.

Where the stock depends chiefly or largely on local spatting, the spat settles on cultch and no man can know what proportion of it dies before the stock reaches the smallest size at which it is dredged and redistributed. When again placed upon the beds it is mostly in deepish water, and the same is often the case with small stock imported. It is difficult enough to actually clear a bed that can be reached by hand-picking and raking, as we have occasion to know from our experience at Burren, where after beds had been reported as absolutely stripped, re-searches at intervals never failed to produce more or fewer remnants. Much greater is the difficulty when the bed is cleared by the more expensive method of dredging, and since the same sites are used over and over again for successive layings, an estimate of loss in each laying appears to be inevitably vitiated by the impossibility of determining either the initial or the final error.† It is too much to ask of professional growers so exact a return of their layings and raisings as would throw much light on the matter, and, in effect, from this source of information we are not able to deduce a great deal. It appears that from the stage at which oysters are first handled, the rate of mortality increases with each successive year, but we cannot attempt to state any percentage of general applicability. This much, however, seems from the consensus of opinion to be certain—that when the oysters attain marketable size the mortality increases enormously, so much so that to carry marketable oysters over the summer is reckoned an unprofitable transaction, and we may say at once that our own experience in no way contradicts this proposition. Of the losses sustained in the Continental system of "parquage," in which no important error is possible, we have not been able to obtain very exact information, but the differences of climatic conditions appear to be such as to render it inadvisable to depend too largely, for home purposes, on these exotic data.

We have hitherto spoken of losses generally without seeking to distinguish between those due to mortality and those which may arise from other causes. What is not found cannot be sold, at least in ordinary trade transactions, and therefore to the relayer the living stock upon which he can lay hands when wanted is alone to be considered as an asset of immediate value.

In the several tables which follow, and more particularly in those which deal with the first year of the experiment, will be found detailed the numbers of oysters raised, whether as samples for examination prior to stocktaking or at stocktaking, or by re-searches subsequent to it; it will be noted that the re-searches yielded very poor returns, the numbers raised being altogether disproportionate to the expense entailed, or to the possible number to be obtained; the numbers have, however, been included in

* Bulstrode, in 24th Ann. Rep. Loc. Govt. Bd., England, 1894-5 [C.—8214], 1896, refers on several occasions to the great mortality sometimes experienced in winter layings, &c., in England.

† *Cf.* Hoek, *op. cit.*, cap. IV.

the tables aud summaries as the oysters so found appear in the subsequent relayings. They are not, however, included in data upon which we have based our summary of the hypothetical profits and losses of the layings. At stocktaking in the second year (1903) the beds were given a thorough searching, and were, so far as it was possible to judge, cleared; later a general further search was made and a considerable number of miscellaneous oysters were forthcoming. These have not been included in the tables or summaries, as it was not possible to allocate those so recovered to their respective original layings. The numbers do not, however, in individual lots, affect materially the figures given either in respect to the number raised or to the missing, though from all sources the total amounted to about **5,000**. Doubtless a cultivator when times are slack would find it profitable to employ his own time or that of his permanent staff in researching apparently stripped beds.

Owing to the quantity of dead shells always present on an oyster bed of old standing, mortality can hardly be ascertained with even approximate exactness on a ground-laying, especially because "clappers" (dead shells still united by the hinge) are very liable to cause confusion by drifting. This renders it impossible to determine the losses from mortality by the number of dead shells recovered; but we must not be taken to imply that the living oysters from different layings were mixed. Layings were always separated by bare intervals or by parc walls or single-stone walls within the parcs, and in general precautions were taken that oysters of a similar character should not be laid on adjacent beds, but should have as neighbours oysters with which there was no possibility of confusion: where this was not done, or where by any reason oysters of different qualities or sizes were raised together, the fact has been noted in the tables, or else the layings in question have been omitted entirely from consideration.

In some layings, however, the action of the tide was so strong as to give us reason to believe that a perhaps not inconsiderable proportion of the missing were swept on to adjacent ground, where, be it remarked, it would not have paid us to search for them, had the ground been our own.

Our records of losses on ground layings are, therefore, comprehensive of those arising from mortality or impossibility of recovery, whether this latter be due to drifting, action of sand, or otherwise. The caisse records of losses include practically only losses by death. Theoretically caisse results should be less satisfactory than those of ground layings, as being further removed from the natural conditions.* Practically they generally proved to be somewhat better in growth and condition of oysters, and from this we infer that the actual mortality on the ground layings was probably not less than that in the caisses.

It was possible for us, by eliminating the results of some layings made on sites always regarded as of doubtful value, to have considerably reduced the return of losses, and to have thus presented to the intending relayer a more alluring prospect. We have abstained from doing so because it seems wiser to present the possible profit at the **minimum**, and perhaps an inexperienced relayer would lose at least as much by injudicious selection of ground. Great as the tables show them to be, the difference between our layings and raisings is not greater than that shown in the returns, to which we have had access, of layings made under the superintendence of a "practical" man of long experience, while the marketable oysters which we raised and sold are acknowledged by the purchasing firm to have been received with universal favour.

For these reasons, while quite willing to admit that some west coast beds may give, in regard to loss, more satisfactory results (and others, perhaps, less), we would most seriously direct the attention of intending relayers to a study of our tables. The proposition that oysters can be bought for **1s.** per hundred and resold when fit for market for **12s.**, is not

* Though, as Dr. Hoek has suggested in conversation to one of us, the sand or mud which inevitably lodges in a caisse may render the conditions of food production not wholly dissimilar.

to be disproved, but whoever expects 11*s*. profit, or anything like it, on the transaction is doomed to much disappointment.

Dr. Hoek's paper, to which we have already occasion to refer, contains, *passim*, the most important information about mortality. With a further communications we hope, with his permission, to publish a translation of the chapters which seem to be of most interest to Irish relayers.

viii.—Overcrowding.

In general the tables show that in the history of any oysters which we laid for more than one season the mortality, in ground layings, was greatest in the second season. This seems to agree with what we have been able to learn from practical men of their own experience, and it may be that our stock suffered unduly from over-much handling and exposure at the end of the first season. It is also the case that for the most part they were more crowded during the second season, not in regard to the distribution of individual oysters in each laying, but to the crowding of many layings into a comparatively small area, wherein, moreover, though constantly covered with water retained by artificial parc walls, they were deprived of the constant ebb or flow incidental to a laying entirely below low water mark. We do not think that this overcrowding was really sufficient to injuriously affect the oysters, partly because stock crowded to an equally great degree, though on only a section of the same area, did well during the previous season, and partly because caisses erected within the same area during the second season gave good results.

We think, however, that in the Ardfry work, not included in this report, some of our losses are due to overcrowding, and would suggest to relayers that the concentration of layings in small areas may result in a degree of starvation which will more than discount the convenience of handling.*

A comparison of the results of laying different numbers of oysters in a caisse is attempted elsewhere (see p. 269).

Dr. Hoek (*op. cit.*) in reporting on the result of his experiments in Holland, in effect attributes the unsatisfactory condition of the Zealand oyster-beds to over-stocking, the beds being asked to carry more than they can feed. The result appears to be that Zealand oysters now take longer to come to maturity than in the days prior to over-prodnction, and are therefore the longer exposed to risk of mortality. Further, he holds that, by the carrying over of the slower growers, there has been attained a survival for breeding purposes of the unfittest, which tends to the degeneration of the stock. Since, however, he shows that the Zealand oyster, if sent to less impoverished grounds, still makes a good oyster, this degeneration would seem to us not wholly proved.† With the view that these slow-growing oysters are of little importance for further culture our experience at Burren leads us to agree, and we are disposed to advise relayers to get rid of obviously old stock which jnst fails to reach market standard at any price they will fetch, rather than carry them through the next summer.

Hoek's conclusion that oysters with sound shells contain better fish than those with injured shells seems to be in agreement with our experience that oysters which increase in shell measurement also improve in weight and condition of fish, while those that remain stunted in shell, with us as at Zealand, may make heavier shell, but are on the whole not disposed to improvement of fish. Worm and sponge, which were among the causes of injury to the shell in the Zealand experiments, were certainly not common at Burren.

* *Cf.* Bouchon-Brandeley—Rapport au Ministre de la Marine relatif à l'Ostréiculture, 1877, pp. 26, 27.

† But in an earlier report he considered that much of the spat in the Scheldt came from wild oysters on the embankments, and not from stock on the cultivated beds [Tijd. Nederland. Dierkund. Vereen., Supp. Deel I, p. 245, 1883].

R 2

II. TABULATION OF RESULTS.

i.—Tralees and Clarenbridges.

Tables I. to VII.

In the main the details given in these tables are, for practical purposes, sufficiently summarised in the section (p. 325) dealing with the hypothetical profits and losses revealed by our operations. The losses of stock are abstracted on pp. 311-2).

For relaying over a season these varieties proved the most satisfactory of all which we handled, and the numbers, especially in the case of Tralees, being large, the results are fairly reliable. The Tralees, raised at the end of the first season, were quite satisfactory in condition, the 3″ oysters in particular being exceptionally fine, while the 2½″ were up to market requirements. It will be seen that the 3″ averaged from 56·4 to 91·4 grm. in gross weight, and from 6·8 to 11·7 in weight of fish, the samples of all sizes averaging in condition of fish over 60% of "fat," in addition to a fair percentage of "very fat." Clarenbridges were about the same in condition and gross weight; 3″ samples averaged from 53·3 to 94·3 grm., and from 7·7 to 9·1 in weight of fish, the 2½″ being also good. Except the price there appeared to be nothing between the two varieties.

It is not possible to institute a fair comparison between the results of raising of the two qualities at the end of the second year, as the layings varied so much in number (*vide* Tables II. and VI). The actual results of the examination at the end of the second year are fairly satisfactory as far as the quality of fish is concerned, as will be seen from an examination of the weights of the samples examined in Tables II. and VI.; the percentage of fat oysters is not so high, but this may in part be due to the personal equation in judging them, and to early date of raising.

The most unsatisfactory result in the second year was the loss, which for Clarenbridges amounted to 600 per thousand laid, and for Tralees to 465 per thousand laid.

A small sample of the first year's consignment of Tralees was laid in caisses (see Table III.), and a comparison with the layings from which these samples were taken shows that the caisse oysters increased proportionately more in size (as judged by the Auray gauge) while differing very little in fish weights, the condition of the fish being in favour of the samples taken from the caisses.

The losses on the caisse oysters were 336 per thousand laid as against 465 per thousand for the large ground layings and 630 per thousand laid in a small check laying by one of these caisses.

The second consignments of Tralees and Clarenbridges were laid mainly with a view to find out whether equally satisfactory results in growth, increase in weight (gross and fish), etc., were obtainable from these oysters when cultivated in caisses as when laid on the ground. (*Vide* pp. 325-6 and 329, and Tables IV. and VII.)

The oysters used for the experiment consisted of 4,165 Tralees in six caisses, and 1,400 laid on the ground; of the Clarenbridges 3,500 were laid in six caisses and 1,200 on the ground.

The oysters had been dredged during the preceding open season, but do not, in the case of the Tralees, quite represent the quality of oysters dredged, as the largest (3″ or over) oysters had been disposed of prior to their purchase for this experiment. To what extent the larger oysters may have been culled from the Clarenbridge lot, before it was sold to us, we do not know. Each caisse, with the exception of one of Tralees on Illaunacraggah, was checked by a laying on the ground near it.

The contents of the caisses and ground layings were raised in September and October, 1903, and were weighed, resized into half-inch sizes, and samples were examined. It was found that the caisse oysters made a better growth, and that a comparison between the weights, gross and fish, with those from ground layings left little to choose between the two methods.

The condition of the "fish" of the marketable oysters was considerably better in samples taken from caisses than from ground layings; thus for Tralees the proportion of "fat or very fat" was 58% for caisse oysters, and only 34% for ground layings; for Clarenbridges the figures were 51% for caisse samples and 31% for samples from ground layings.

This is of considerable importance, as one of the difficulties of oyster growers in this country is to bring their oysters into good condition early in the season.*

A further advantage which the caisse system appears to possess is the decreased loss; in this particular experiment the losses on the check ground layings were almost double those of the caisses. The actual figures were:—

Tralee oysters in Caisses.	Total losses,	209	per	thousand laid.
Do. on the ground.	,,	400	,,	,,
Clarenbridge oysters in Caisses.	,,	129	,,	,,
Do. on the ground.	,,	253	,,	,,

* The season for high-class oysters appears to be dictated by the assumption that oysters spawn early in summer, and in English waters they no doubt often spawn as early as May. With rather exceptional opportunities of observation I have not in the last few years seen any Irish oyster "sick" in May, and do not think that many spawn before July. If this is so, it is natural that many should be still out of condition at the beginning of September, when the demand for high-class oysters begins.—E.W.L.H.

[TABLES

GROUND LAYINGS

Tralee Oysters, First Consignment.

Reference Number.	Date.	Quality.	Bed.	Total Number Laid.	Size.	Date of Raising.	Total No. Raised (Living).	Total Losses, including Dead and Missing	NUMBER 3½″	Average Gross weight in Grmes.	3″
1	30. xi. 01 to 13. ii. 02.	Tralee, (direct).	Hynes Deep 8.	11,238			7,968	3 270	154	–	4,473
				4,860	3″ and over 3″	10. vi. 02. 19. vii. 02. 2. ix. 02.	1,000 50 50		– – –	– – –	1,000 50 50
				6,378	3″	30. ix. 02 to 20. x. 02.	6,868		154	1097	3,373
2	12. xii. 01 to 14. ii. 02.	Tralee, (direct).	Hynes Deep 7.	35,468	2½″		23,859	11,609	–	–	7,542
						2. vii. 02. 9. x. 02 to 28. xi. 02.	50 23,620		– –	– –	– 7,479
						7. vii. 03.	189		–	–	63
3	30. xi. 01 to 2. xii. 01.	Tralee, (direct).	Hynes Deep 6a and b.	14,646	2½″		7,925	6,620	–	–	2.335
						19. vii. 02. 7. xi. 02 to 19. xi. 02	50 7,563		– –	– –	– 2,283
						6. vii. 03.	312		–	–	52
4	10. xii. 01 to 13. ii. 02.	Tralee, (direct).	Illauna-craggah 4 and 5.	17,010			6,318	10,692	–	–	854
				10,010 7,000	2½″ 2″	19. vii. 02 2. ix. 02. 6. x. 02.	50 50 10		– – –	– – –	– – –
						29. xi. 02.	6,208		–	–	854
5	2. i. 02 to 13. ii. 02.	Tralee. (direct).	Hynes Deep 4a and b.	14,000	2″		4,817	9.183	–	–	812
						20. v. 02	(200)[b]		–	–	–
						21. ii. 03. 24/25. ix. 03.	4,652 165		– –	– –	769 43
6	21. i. 02.	Tralee, (direct).	Hynes Deep 10.	7,085	2″	27. xii. 02.	2,931	4,154	–	–	543
7	—. xi. 01. to 8. 1. 02.	Tralee, (direct).	Hynes Deep 5a and b.	13,680	2″		8,115	5,565	–	–	842
						2. ix. 02 10. xii. 02. 24. vi. 03.	50 7,944 121		– – –	– – –	– 828 14
8	14. ii. 02	Tralee (direct).	Illauna-craggah Reserve.	4,565	2″	13. ii. 03.	775	3,790	–	–	60
9	21. i. 02.	Tralee, (direct).	Curtin 2 d.	500	2″	3. ii. 03	157	343	–	–	26
10	8. i. 02.	Tralee, (direct).	Red Bank f.	5,000	2″		4,247[c]	2,448[e] (10 and 10A)	–	–	–
						20. v. 02. 12. vi. 02.	3,950[c] 297[c]		– –	– –	– –
10A	–	Tralee from Red Bank f. See Ref. No 10.	Arklow 10 b.	4,247	–		2,552		–	–	133
						19. xii. 02. 29. xii. 02.	2,435 117		– –	– –	133 –

[a] Spat romoved from shells. [b] Returned to Bed after weighing.
[e] Includes the lossee of this laying while on Red Bank f, and, after transfer, on Arklow 10b.

I.

AT BURREN.

Results of Raising at Stock-taking of 1st Year.

RAISED (LIVING), WITH SIZES AND AVERAGE WEIGHTS.													
Average Gross Weight in Grmes.	Fish Weight.		$2\frac{1}{4}''$	Average Gross Weight in Grmes.	Fish Weight.		$2''$	Average Gross Weight in Grmes.	Fish Weight.		Not Sized.		Reference Number.
	No. Examined	Average Weight in Grmes.			No. Examined	Average Weight in Grmes.			No. Examined	Average Weight in Grmes.	No.	Average Gross Weight in Grmes.	
–	–	–	2,271	–	–	–	1,070	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	
77·9	20	7·5	–	–	–	–	–	–	–	–	–	–	
91·4	50	11·7	–	–	–	–	–	–	–	–	–	–	
89·7	–	–	2,271	72·0	–	–	1,070	–	–	–	290[a]	–	
–	–	–	12,659	–	–	–	3,658	–	–	–	–	–	2
–	–	–	50	57·7	50	7·7	–	–	–	–	–	–	
77·1	50	9·0	12,526	55·3	50	7·7	3,615	47·2	50	6·6	1,426[a]	–	
–	–	–	83	–	–	–	43	–	–	–	–	–	
–	–	–	3,414	–	–	–	2,176	–	–	–	–	–	3
–	–	–	50	53·6	25	5·7	–	–	–	–	–	–	
67·0	–	–	3,221	55·3	–	–	2,059	40·8	–	–	499[a]	–	
–	–	–	143	–	–	–	117	–	–	–	–	–	
–	–	–	2,955	–	–	–	2,499	–	–	–	10	–	4
–	–	–	50	59·1	25	5·4	–	–	–	–	–	–	
–	–	–	50	58·9	50	7·5	–	–	–	–	–	–	
–	–	–	–	–	–	–	–	–	–	–	10	–	
65·0	50	9·2	2,855	61·5	50	7·2	2,499	45·3	50	5·0	475[a]	–	
–	–	–	2,450	–	–	–	1,555	–	–	–	–	–	5
–	–	–	–	–	–	–	–	–	–	–	(200)[b]	38·0	
66·0	50	8·8	2,362	53·3	50	6·8	1,521	42·3	50	5·0	183[a]	–	
–	–	–	88	–	–	–	34	–	–	–	–	–	
63·0	50	7·8	1,362	51·3	50	6·6	1,026	41·3	50	5·4	67[a]	–	6
–	–	–	4,074	–	–	–	3,187	–	–	–	12	–	7
–	–	–	–	–	–	–	50	47·5	50	6·7	–	–	
59·6	50	8·6	4,016	51·1	50	6·7	3,100	40·0	50	5·6	433[a]	–	
–	–	–	58	–	–	–	37	–	–	–	12	–	
82·5	50	7·8	382	55·8	50	6·8	333	40·5	50	4·8	–	–	8
70·2	–	–	81	55·0	50	6·7	50	44·0	50	5·0	–	–	9
–	–	–	–	–	–	–	–	–	–	–	4,247	–	10
–	–	–	–	–	–	–	–	–	–	–	3,950[c]	39·0[f]	
–	–	–	–	–	–	–	–	–	–	–	297[c]	–	
–	–	–	1,244	–	–	–	1,175	–	–	–	–	–	10A
56·4	50	6·8	1,197	48·3	50	5·5	1,105	40·3	50	4·6	–	–	
–	–	–	47	–	–	–	70	–	–	–	–	–	

c Not sized. Transferred. See Ref. No. 10A. d Total number raised at end of season.
f From sample of 200.

TABLE

GROUND LAYINGS

TRALEE OYSTERS, FIRST CONSIGNMENT (RELAID).

Reference Number.	Date of Laying.	Quality.	Bed.	Total Numbers Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Dates of Raising.	Total Numbers Raised. (Living).	Losses, including Dead and Missing.
11	—. i. 03 to 21. ii. 03.		Arklow 13e.	901				13. x. 03.	570	331
		Tralee 2″. Relaid. See Ref. No. 5.		719	3″	66·0	8·8			
		Do. See Ref. No. 8.		10	„	82·5	7·8			
	7. vii. 03	Tralee 2½″. Relaid. See Ref. No. 2.		63	„	-	-			
	6. vii. 03.	Do. See Ref. No. 3.		52	„	-	-			
	24. vi. 03.	Tralee 2″. Relaid. See Ref. No. 7.		14	„	-	-			
	24/25. ix. 03.	Do. See Ref. No. 5.		43	„	-	-			
12	9. x. 02 to 5. xii. 02.		Hynes Deep 2a.	7,673				22. x. 03.	3,088	4,585
		Tralee 2½″. Relaid. See Ref. No. 2.		3,140	2½″	55·3	7·7			
		Do. See Ref. No. 6.		1,312	„	51·3	6·6			
		Tralee 2″. Relaid. See Ref. No. 3.		3,221	„	55·3	-			
13	29. xi. 02 to 4. ii. 03.		Arklow 12a.	10,922					6,550	4,372
		Tralee 2″ & 2½″. Relaid. See Ref. No. 4.		2,805	2½″	61·5	7·2	18. xii. 02.	1,200 [b]	
		Tralee 2″. Relaid. See Ref. No. 7.		3,966	„	51·1	6·7	13. x. 03.	5,350	
		Do. See Ref. No. 10.		1,192	„	48·3	5·5			
		Do. See Ref. No. 9.		31	„	55·0	6·7			
		Do. See Ref. No. 5.		2,312	„	53·3	6·8			
		Do. See Ref. No. 8.		332	„	55·8	6·8			
	24. vi. 03 to 7. vii. 03.	Tralee 2″. Relaid. See Ref. No. 5.		58	„	-	-			
		Tralee 2½″. Relaid. See Ref. No. 3.		143	„	-	-			
		Do. See Ref. No. 2.		83	„	-	-			

(a) Sample of 10, average

(b) 600 transferred to caisse xxii., xxiii., xxiv., see Ref. No. 19.

II.

AT BURREN.

Results of Raising at Stocktaking of 2nd Year.

Numbers raised (living), with Sizes and Average Weights.															
				Fish Weight.				Fish Weight.				Fish Weight.			
3½".	Average Gross Weight in Grmes.	3".	Average Gross Weight in Grmes.	No. Examined.	Average Weight in Grmes.	2½".	Average Gross Weight in Grmes.	No. Examined.	Average Weight in Grmes.	2".	Average Gross Weight in Grmes.	No. Examined.	Average Weight in Grmes.	Reference Number.
11[a]	100·0	237	77·5	50	9·2	322	68·8	50	7·6	-	-	-	-	11
-	-	309	78·4	50	10·1	2,455	65·1	50	10·1	324	52·1	50	7·6	12
-	-	39	-	-	-	4,624	-	-	-	1,887	-	-	-	13
	-	-	-	-	-	1,200[b]	-	-	-	-	-	-	-	
-	-	39	73·1	10	11·5	3,424	60·6	50	7·8	1,887	50·7	50	7·0	

[a] ...fish weight 10·5 grmes.
[b] ...and 600 transferred to ground beside same caisse, see Ref. No. 20.

TABLE

GROUND LAYINGS

TRALEE OYSTERS, FIRST CONSIGNMENT (RELAID).

Reference Number.	Date of Laying.	Quality.	Bed.	Total Numbers Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Dates of Raising.	Total Number Raised (Living).	Losses, including Dead and Missing.
14	3. x. 02 to 28. xi. 02.		Arklow 15.	11,704					7,871	3,833
		Tralee 3". Relaid. See Ref. No. 1.		2,271	2½"	72·0	-	13. xii. 02.	600 (a)	
								15. xii. 02.	600 (b)	
		Tralee 2½". Relaid. See Ref. No. 2.		9,336	2½"	55·3	7·7	14. x. 03.	6,119	
	24/26. ix. 03.	Tralee 2". Relaid. See Ref. Nos. 5, 10.		97	2½"	-	-	17. x. 03.	304	
								9. xi. 03.	248	
15	9. x. 02 to 6. xii. 02.		Arklow 16.	7,704					3,770	3,934
		Tralee 3". Relaid. See Ref. No. 1.		1,070	2"	-	-	17. x. 03.	3,537	
								9. xi. 03.	233	
		Tralee 2½". Relaid. See Ref. No. 2.		3,565	"	47·2	6·6			
		Do. See Ref. No. 3.		2,059	"	40·8	-			
		Tralee 2". Relaid. See Ref. No. 6.		976	"	41·3	5·4			
	24/25. ix. 03.	Do. See Ref. No. 5.		34	"	-	-			
16	29. xi. 02. to 21. ii. 03.		Arklow 17.	8,575				9. x. 03.	4,652	3,923
		Tralee 2". Relaid. See Ref. No. 7.		3,050	2"	40·0	5·6			
		Do. See Ref. No. 10.		1,055	"	40·3	4·6			
		Do. See Ref. No. 5.		1,471	"	42·3	5·0			
		Do. See Ref. No. 8.		283	"	40·5	4·8			
		Do. See Ref. No. 10.		70	"	-	-			
		Tralee 2½" & 2". Relaid. See Ref. No. 4.		2,449	"	45·3	5·0			
	24. vi. 03 to 7. vii. 03.	Tralee 2". Relaid. See Ref. No. 7.		37	"	-	-			
		Tralee 2½". Relaid. See Ref. Nos. 2, 3.		160	"	-	-			

(a) Transferred to caisse xvi.,
(b) " " xix.,
(c) Average fish weight

II.—*continued.*

AT BURREN.

Results of Raising at Stocktaking of 2nd year.

Numbers raised (living), with sizes and average weights.															Reference Number.
3".	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2½'.	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2"	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	1½".	Average Gross Weight in Grmes.	
303	-	-	-	6,915	-	-	-	653	-	-	-	-	-	14
-	-	-	-	600[a]	-	-	-	-	-	-	-	-	-	
-	-	-	-	600[b]	-	-	-	-	-	-	-	-	-	
273	85·6	50	11·8	5,258	69·9	50	9·4	588	55·7	50	7·1	-	-	
11	81·8	-	-	259	66·6	-	-	34	45·6	-	-	-	-	
19	-	-	-	198	-	-	-	31	-	-	-	-	-	
30	-	-	-	1,225	-	-	-	2,451	-	-	-	64	-	15
26	71·2	-	-	1,144	61·8	50	9·2	2,303	49·3	50	7·1	64	32·8	
4	-	-	-	81	-	-	-	148	-	-	-	-	-	
-	-	-	-	353	56·9	52	8·2	4,002	45·1	50	5·8	297[c]	31·0	16

xvii., xviii. See Ref. No. 17.
xx., xxi. See Ref. No. 18.
of 50 examined—4·5 grmes.

TABLI

CAISSE EXPERIMENTS

TRALEE OYSTERS, FIRST CONSIGNMENT (RELAID). Oysters transferred from at Stock-taking

Reference Number.	Date of Laying.	Quality.	Caisse Number.	Position on Beds.	Total Number of Oysters in Caisse or Laying, and in each Division of Caisse.	Size.	Date of Raising.	Total Number of Oysters raised (Living) from Caisse or Laying, and from each Division of Caisse.
17	13. xii. 02.	Tralee. (Relaid). See Ref. No. 14.	*XVI., *XVII., *XVIII.	Arklow.	600 XVI., 200 XVII., 200 XVIII., 200	2½"	15. ix. 03.	406 XVI., 129 XVII., 146 XVIII., 131
18	15. xii. 02.	Tralee. (Relaid). See Ref. No. 14.	*XIX., *XX., *XXI.	Arklow.	600 XIX., 200 XX., 200 XXI., 200	2½"	9. x. 03.	373 XIX. 130 XX., 120 XXI., 123
19	18. xii. 02.	Tralee. (Relaid). See Ref. No. 13.	*XXII., *XXIII., *XXIV.	Illauna-craggah.	600 XXII., 200 XXIII., 200 XXIV., 200	2½"	26. x. 03.	421[c] XXII., 140 XXIII., 145 XXIV., 136
20	18. xii. 02.	Tralee. (Relaid). See Ref. No. 13.	Laying beside Caisse. XXII., XXIII., XXIV.	Illauna-craggah.	600	2½"	9. xi. 03.	222

a 14 Dead Shells removed from

b In each of the above instances the number of oysters weighed was the multiple

c This includes an excess

* Caisse with cover.

II.

AT BURREN

Ground Layings to Caisses after Stock-taking of 1st Year. Results of Raising of 2nd Year.

TOTAL LOSSES.		NUMBER RAISED (LIVING), WITH SIZES AND AVERAGE WEIGHTS.												Reference Number.
Dead Shells Removed.	Number Missing at Final Count.	3″	Average Gross weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average weight in Grmes.	2½″	Average Gross weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average weight in Grmes	2″	Average Gross weight in Grmes	Fish Weight. No. Examined.	Fish Weight. Average weight in Grmes.	
179+14[a]	1	62	-	-	-	323	-	-	-	21	-	-	-	17
61	1	25	90·0	10	14·0	97	71·6	50	11·1	7	45·0	-	-	
58		20	82·5	-	-	118	65·3	-	-	8	48·2	-	-	
60		17	83·8	-	-	108	75·7	-	-	6	65·8	-	-	
211	16	11	-	-	-	232	-	-	-	130	-	-	-	18
63	7	5	95·0	-	-	105	77·2	50	9·5	20	56·3	-	-	
73	7	6	90·0	-	-	85	71·0	-	-	29	54·3	-	-	
75	2	-	-	-	-	42	60·7	10	10·5	81	50·3	25	7·4	
182	2	66	-	-	-	327	-	-	-	28	-	-	-	19
58	2	31[b]	75·0	10	9·5	104[b]	62·5	50	8·1	5	47·0	-	-	
65	0	11[b]	75·0	-	-	123[b]	61·5	50	7·4	11[b]	62·5	-	-	
69	Excess of 5.	24[b]	75·0	-	-	100	61·3	50	8·2	12	52·1	-	-	
378 (including dead and missing.)		16[b]	71·5	-	-	156[b]	55·0	50	7·4	50	47·5	50	6·0	20

Divisions XVI., XVII., XVIII. 11.3.03.
of ten next below the numbers given above, *e.g.*, 31. 3″. 30 were weighed, &c.
of 5 in Division XXIV.

TABLE

CAISSE EXPERIMENTS

TRALEE OYSTERS, SECOND CONSIGNMENT.

Date of Laying.	Quality.	Caisse Number.	Position on Beds.	Total No. of Oysters in Caisse or Laying, and Number in each Division of Caisse.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Total No. of Oysters raised (living) from Caisse or Laying, and from each Division of Caisse.
13. xii. 02.	Tralee, (direct).	*XIII., *XIV., *XV.	Arklow.	600 XIII., 200 XIV., 200 XV., 200	2½″	48·5 from sample of 50. (26. xii. 02.)	6·2 from sample of 50. (26. xii. 02.)	9. ix. 03.	460 [a] 10 [b] XIII., 128 XIV., 166 XV., 156
13. xii. 02.	Do.	Laying beside Caisse XIII., XIV., XV.	do.	600	2½″	do.	do.	do.	263
13. i. 03.	Tralee, (direct).	†LV., †LVI., †LVII.	Parkmore.	600 LV., 300 LVI., 200 LVII., 100	2½″	As above.	As above.	10. ix. 03.	472 LV., 238 LVI., 155 LVII., 79
13. i. 03.	Do.	Laying beside Caisse LV., LVI., LVII.	do.	200	2½″	do.	do.	9. ix. 03.	162
13. i. 03.	Tralee, (direct).	*LXIV., *LXV., *LXVI.	Hynes Deep 3.	600 LXIV., 100 LXV., 200 LXVI., 300	2½″	As above.	As above.	9. ix. 03.	499 LXIV., LXV., LXVI. } 499 [f]
13. i. 03.	Do.	Laying beside Caisse LXIV., LXV., LXVI.	do.	200	2½″	do.	do.	9. ix. 03.	162
13. i. 03.	Tralee, (direct).	†LXVII., †LXVIII., †LXIX.	Illaunacraggah.	565 LXVII., 300 LXVIII., 200 LXIX., 65	2½″	As above.	As above.	25. x. 03.	440 LXVII., 229 LXVIII., 162 LXIX., 49
12. i. 03.	Tralee, (direct).	†XXVIII., †XXIX., †XXX.	Parkmore.	900 XXVIII., 200 XXIX., 300 XXX., 400	2″	40·0 from sample of 50. (26. xii. 02.)	4·9 from sample of 50. (26. xii. 02.)	10. ix. 03.	765 [k] XXVIII., 209 XXIX., 218 XXX., 338
12. i. 03.	Do.	Laying beside Caisse XXVIII., XXIX., XXX.	do.	200	2″	do.	do.	9. ix. 03	134
13. i. 03.	Tralee, (direct).	†LXI., †LXII., †LXIII.	Illaunacraggah.	900 LXI., 400 LXII., 300 LXIII., 200	2″	40·0	4·9	30. x. 03.	658 LXI., 308 LXII., 225 LXIII., 125
13. i. 03.	Do.	Laying beside Caisse LXI., LXII., LXIII.	do.	200	2″	do.	do.	30. x. 03.	119

* Caisse with cover. † Caisse without cover.

(a) Includes an Excess of 3 as found at final count. (b) 10. Removed for examination, 11. iii. 03. (d) Average gross weight 59·5 grmes. (e) Average gross weight of 31, 46·8 grmes. (f) On August 25, 1903, the wire bottom of this Caisse was broken, and the oysters, originally laid in separate divisions, were mixed. (g) In each of the

IV.

AT BURREN.

Results of Raising at Stock-taking of 2nd Year.

TOTAL LOSSES.		NUMBERS RAISED (LIVING), WITH SIZES AND AVERAGE WEIGHTS.											
Dead Shells Removed.	Number Missing at Final Count.	3″	Average Gross weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average weight in Grmes	2½″	Average Gross weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average weight in Grmes.	2″	Average Gross weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average weight in Grmes.
102	41	62	–	–	–	331	–	–	–	57	–	–	–
33 37 32	29 (Excess 3) 12	9 20 33	66·7 68·8 66·7	– 20 } 33 }	– 10·5 {	96 125 110	55·9 57·0 58·2	– 49 –	– 8·6 –	23 21 13	48·9 47·6 51·9	23 21 6	} 8·2
337 (including both dead and missing.)		16	69·4	–	–	174	60·9	50	9·3	73	50·7	49	7·4
51	77	76	–	–	–	364	–	–	–	32	–	–	–
26 16 9	} 77 {	30 30 16	65·0 70·0 65·6	30 } 4 } 50 [d] 16 }	9·1 {	189 115 60	52·9 53·3 54·2	50 – –	5·9 – –	19 10 3	48·2 43·5 45·0	19 } 10 } 32 [e] 3 }	5·8
38 (including both dead and missing.)		1	65·0	–	–	85	54·7	50	7·1	76	47·4	49	8 8
88	13	38	–	–	–	350	–	–	–	111	–	–	–
88	13	38	66·3	37	11·2	350	56·1	50	9 3	111	48·0	57	7 6
38 (including both dead and missing.)		10	66·5	–	–	111	57·7	49	8 7	41	45·7	–	–
39	86	93	–	–	–	299	–	–	–	48	–	–	–
19	52	41 [g]	75·0	10 [h]	10·5	161 [g]	60·2	50	8·6	27 [g]	68·8	–	–
13	25	37 [g]	79·2	10	10·0	110	59·1	50	7·6	15 [g]	62·5	–	–
7	9	15 [g]	57·5	–	–	28 [g]	68·8	–	–	6	47·3	–	–
57	78	2	–	–	–	128	–	–	–	635	–	–	–
15 17 25	} 78 {	1 1 –	55·0 55·0 –	– – –	– – –	35 56 37	46·4 44·2 46·6	– 13 } 50 37 }	– 5·7 {	173 161 301	38·4 38·2 38·6	– – [i] 49	– – 6 8
66 (including both dead and missing.)		–	–	–	–	5	48·0	–	–	129	38·2	50	5·8
79	163	24	–	–	–	381	–	–	–	253	–	–	–
20	72	12 [g]	75·0	–	–	173 [g]	48·5	50	6·5	123 [g]	41·7	50	5·3
14	61	7	57·9	–	–	141 [g]	50·0	50	6·6	77 [g]	42·9	10 [j]	5·0
45	30	5	60·0	–	–	67 [g]	52·1	10	7·5	53 [g]	45·0	10	6·0
81 (including both dead and missing.)		–	–	–	–	67 [g]	58·3	10	8·5	52 [g]	47·5	10	6·0

above instances, the number of oysters weighed was the multiple of ten next below the numbers given above. e.g. 41, 3″. 40 were weighed, etc. (h) Average gross weight 87·5 grmes. (i) These (49) were weighed with all their liquor. (j) Average gross weight 36·0 grmes. (k) This Caisse was not covered, and there appears to have been a redistribution of the oysters.

TABLE

GROUND LAYINGS

CLARINBRIDGE OYSTERS, FIRST CONSIGNMENT.

Reference Number.	Date.	Quality.	Bed.	Total Number Laid.	Size.	Dates of Raising.	Numbers Raised (Living).	Losses including Dead and Missing
1	27. iii. 02.	Clarinbridge (direct).	Illaunacraggah 6.	362	3″	17. x. 02.	200	162
2	27. iii. 02.	Clarinbridge (direct).	Arklow Reserve.	400	3″	7. iv. 02. 20/22. ix. 02.	251 100[b] (153)[a]	149[c]
2A	22. ix. 02.	Clarinbridge from Arklow Reserve. See above.	Arklow, 13 b.	(153)	(3″)	4. xi. 02.	151	
3	27. iii. 02.	Clarinbridge (direct).	Illaunacraggah 6.	1,008	2½″	18. x. 02.	846	162
4	27. iii. 02.	Clarinbridge (direct).	Arklow Reserve.	1,348	2½″	7. iv. 02. 19. vii. 02. 19. ix. 02. to 18. x. 02.	1,007= 100[b] 50 (933)[a]	341[c]
4A	22. ix. 02. to 18. x. 02.	Clarinbridge from Arklow Reserve. See above.	Arklow, 13 b.	(933)	(2½″)	3. xi. 02.	857	
5	27. iii. 02.	Clarinbridge (direct).	Red Bank d.	1,000	2″	12. vi. 02.	673= (927)[e]	327[e]
5A	20. vi. 02.	Clarinbridge from Red Bank, d. See above.	Arklow, 10 a.	(927)	(2″)	5. xi. 02.	673	
6	27. iii. 02.	Clarinbridge (direct).	Arklow Reserve.	4,346	2″	7. iv. 02. 19. ix. 02. to 18. x. 02.	1,782= 100[b] (1,831)[a]	2,564[c]
6A	22. ix. 02. to 18. x. 02.	Clarinbridge from Arklow Reserve. See above.	Arklow, 13 b.	(1,831)	(2″)	3. xi. 02.	1,682	

a Not sized, transferred to Arklow, 13 b.

b For further history see Table XXIII.

e Not sized, transferred

V.

AT BURREN.

Results of Raising at Stock-taking of 1st Year.

Numbers Raised (Living), with Sizes and Average Weights.																		
						Fish Weight				Fish Weight.				Fish Weight.				
4″	Average Gross weight in Grmes.	3½″	Average Gross weight in Grmes.	3″	Average Gross weight in Grmes.	No. Examined	Average weight in Grmes.	2½″	Average Gross weight in Grmes.	No. Examined.	Average weight in Grmes.	2″	Average Gross weight in Grmes.	No. Examined.	Average weight in Grmes.	1½″	Reference Number.
-	-	-	-	200	93·2	-	-	-	-	-	-	-	-	-	-	-	1
1	-	14	-	135	-	-	-	99	-	-	-	-	-	-	-	-	2
-	-	-	-	100	80·1	10	7·7	-	-	-	-	-	-	-	-	-	
1	158·0	14	110·7	35	94·3	-	-	99	85·1	50	8·1	2	87·5	-	-	-	2A
-	-	-	-	128	74·8	50	9·1	540	62·4	50	7·8	178	53·9	50	6·0	-	3
-	-	-	-	55	-	-	-	746	-	-	-	206	-	-	-	-	4
-	-	-	-	-	-	-	-	100	52·1	10	5·2	-	-	-	-	-	
-	-	-	-	-	-	-	-	50[d]	65·5	25	5·4	-	-	-	-	-	
-	-	-	-	55	71·5	50	8·1	596	62·8	50	6·7	206	58·8	50	5·4	-	4A
-	-	-	-	12	-	-	-	255	-	-	-	406	-	-	-	-	5
-	-	-	-	12	58·7	-	-	255	56·3	50	6·0	406	44·0	50	4·4	-	5A
-	-	-	-	3	-	-	-	251	-	-	-	1,516	-	-	-	12	6
-	-	-	-	-	-	-	-	-	-	-	-	100	39·9	10	4·2	-	
-	-	-	-	3	53·3	-	-	251	48·9	50	4·9	1,415	43·6	50	4·4	12	5A

c Total loss during whole time of laying. to Arklow, 10a.

d 50 of the largest (by eye) were weighed.

TABLE

CAISSE EXPERIMENTS

CLARINBRIDGE OYSTERS. FIRST CONSIGNMENT (RELAID).

Reference Number.	Date	Quality.	Bed.	Total Number Laid.	Size.	Average Gross weight in Grmes.	Average Fish weight in Grmes.	Date of Raising.	Number Raised (Living).
7	18. x. 02.	Clarinbridge 2½". (Relaid). See Ref. No. 3.	Arklow 18.	671= 53 490 128	- 3" 2½" 2"	- 74·8 62·4 53·9	- 9·1 7·8 6·0	4. xi. 03.	271
8	3. xi. 02.	Clarinbridge 2½". (Relaid). See Ref. No. 4A.	Arklow 10 c.	546	2½"	62·8	6·7	3. xi. 03.	152
9	4. xi. 02.	Clarinbridge 2½". (Relaid). See Ref. No. 4A.	Arklow 10 c.	156	2"	58·8	6·4	3. xi. 03.	76
10	5. xi. 02.	Clarinbridge 2". (Relaid). See Ref. No. 5A.	Arklow 26.	573= 12 205 356	- 3" 2½" 2"	- 58·7 56·3 44·0	- - 6·0 4·4	4. xi. 03.	255
11	4. xi. 02.	Clarinbridge 2". (Relaid). See Ref. No. 6A.	Arklow 10 c.	201	2½"	48·9	4·9	3. xi. 03.	95
12	4. xi. 02.	Clarinbridge 2". (Relaid). See Ref. No. 6A.	Arklow 10 c.	1,366	2"	43·6	4·4	13. xi. 03	556

VI.

AT BURREN.

Results of Raising at Stock-taking of 2nd Year.

Losses including Dead and Missing.	Numbers Raised (Living), with Sizes and Average Weights.														Reference Number.
	3½″	Average Gross weight in Grmes.	3″	Average Gross weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average weight in Grmes.	2½″	Average Gross weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average weight in Grmes.	2″	Average Gross weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average weight in Grmes.	
400	10	93·8	105	83·3	25	13·2	139	70·8	50	8·2	17	54·5	-	-	7
394	-	-	46	80·5	10 [a]	10·5	96	69·7	50	8·6	10	57·5	-	-	8
80	-	-	-	-	-	-	54	69·9	10 [b]	10·0	22	59·1	-	-	9
318	-	-	38	79·2	10	10·0	135	60·4	50	7·0	82	45·8	10	5·0	10
106	-	-	10	71·5	-	-	66	60·3	10	8·5	19	53·4	-	-	11
810	-	-	5	74·0	-	-	165	58·5	50	8·1	386	42·3	50	5·7	12

a Average gross weight 75·5 grmes.
b Average gross weight 60·5 grmes.

TABLE VII.

CAISSE EXPERIMENTS AT BURREN

Classification Oysters, Second Consignment. Results of Raising at Stocktaking of 2nd Year

Date of Sowing	Quality	Cultch Number	Position on Beds	Total No. of Oysters in Cultch	Size	Average Gross Weight in Grams	Average Flat Weight in Grams	Date of Raising	Total No. of Oysters raised	Total Losses: Dead Shells Recovered	Total Losses: Number Missing	Survivors
1	2	3	4	5	6	7	8	9	10	11	12	13–26
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Do.	[illegible]	do.	[illegible]	[illegible]	do.	do.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Do.	[illegible]	do.	[illegible]	[illegible]	do.	do.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	As above.	As above.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Do.	[illegible]	do.	[illegible]	[illegible]	do.	do.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Do.	[illegible]	do.	[illegible]	[illegible]	do.	do.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	As above.	As above.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Do.	[illegible]	do.	[illegible]	[illegible]	do.	do.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	As above.	As above.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Do.	[illegible]	do.	[illegible]	[illegible]	do.	do.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

ii.—*FRENCH OYSTERS.*

Tables VIII. to XIV.

Arcachons.—The consignment received in 1902 appears to have contained a larger run of oysters than that of 1903, as will be seen from an examination of the numbers of $2\frac{1}{2}''$, $2''$, and $1\frac{1}{2}''$ oysters into which the respective consignments were sorted on their arrival at Burren (see Tables XII. and XIV.), but, on the other hand, the weights of the similar qualities in each consignment did not differ much.

The average gross weights of the oysters of each quality when treated as a whole are:—

	Average gross-weight Grammes.
1st consignment, 1st quality, about	35
1st consignment, 2nd quality, about	27
2nd consignment, 1st quality, about	38
2nd consignment, 2nd quality, about	28

At the end of their respective first seasons both consignments were raised and again sized into half-inches; the following are the figures when reduced to a standard of 1,000 oysters raised:—

—	3″.	2½″.	2″.	1½″.
1st Consignment (Ground), 1st Quality, ...	37	406	556	-
2nd do. (Caisses), do., ...	25	354	603	18
Losses—Ground Layings—309 per thousand laid.				
Caisses— 223 " " "				
1st Consignment (Ground), 2nd Quality, ...	41	393	566	-
2nd do. (Caisses), do., ...	-	90	767	143
Losses—Ground Layings—511 per thousand laid.				
Caisses— 301 " " "				

When the conditions under which the caisse oysters were grown are taken into consideration it does not appear that the ground layings of the 1st quality oysters produced much better results.

The best result for 1st quality Arcachons in caisses was obtained when 200 oysters were laid in each compartment, the relative growth being uniformly less in the compartments where this number was exceeded.

This may be seen by the following figures:—In each instance the results obtained are for purposes of mutual comparison expressed as parts of 1,000.

—	3″.	2½″.	2″.	1½″.
1st Consignment, 1st Quality, Total net Results (Ground),	37	406	556	-
2nd do., do., do., (Caisses),	25	354	603	18
2nd Consignment, 1st Quality, Caisses—				
Laid 200 (2″) to the compartment, ...	34	412	519	34
Laid 400 do., do., ...	27	325	627	21
Laid 600 do., do., ...	27	311	644	18
Laid *ca.* 390 (2½″) to the compartment, ...	12	450	537	-

However, on the other hand, the ground layings of the second quality Arcachons in 1902 produced much better results than were obtained in any of the caisses containing similar oysters in 1903.

The relative difference in growth obtained in the caisses may be seen from the following table, where the results are summarised according to the numbers laid in each compartment.

—	2½".	2".	1½".
2nd Consignment, 2nd Quality, Caisses—			
Laid 200 (2") to the compartment, ...	57	783	160
Laid 323 (2") do., do., ...	127	742	131
Laid 400 (2") do., do., ...	78	768	154
Laid 600 or 647 (2") to the compartment, ...	99	798	103
Laid 973 (2") to the compartment, ...	107	862	32
Laid 272 (1½") do., do., ...	80	686	233
Laid 542 (1½") do., do., ...	108	639	253
Laid 814 (1½") do., do., ...	58	693	250

There is a want of uniformity in these results which must, we think, be attributed to the situation of the caisses, this latter appearing to be a most important factor in determining the growth. (See Table XIV., and Notes of Locality, page 216). It is intended to make a further experiment with these oysters in caisses, the results of which will be checked by having ground layings beside each caisse.

With regard to the weights of the oysters raised from ground layings and from caisses after one season's growth, it would appear that while the weights of the caisse oysters examined vary considerably, they are in some instances better than those from the ground layings, and there does not appear to be any reason why, given suitable conditions, the caisse oysters should not in general give satisfactory results.

On Table XIII. are shown the results obtained from the raising and re-sizing of the first consignments of ground layings at the end of the second season.

The two qualities were not laid separately during the second season, and, owing to a mistake, samples were not taken of the half-inch sizes into which each quality was sorted at the end of the first season. It is thus impossible to trace the relative growth of each quality through the second year. Where a sample was taken (see Ref. 5, Table XIII.) the losses were so heavy as to leave very few oysters available for final examination. On the whole the growth of the ground layings during their second year is unsatisfactory; a large percentage of the number raised showed no increase in size and very little in fish weight.

The losses, which amounted to 491 per thousand laid, must be considered as excessive, as only about 25% of the oysters raised were fit for market, and at the most liberal estimation could not be regarded as more than second grade oysters.

During the second year a small sample (see Ref. No. 10, Table XIII.) of the first consignment was tried in a caisse, and the results obtained were relatively better than those of the ground layings, while the losses were reduced by about 17%.

Aurays.—The first consignment of Aurays when resized on arrival at Burren into half-inch sizes appears to have contained, on the whole, a larger run of oysters than was found in the second consignment when similarly treated; on the other hand a comparison of the average gross weights would seem to show that the similar grades in each consignment were practically identical in weight.

Treating each grade as an entity, and determining its average gross weight from those of the half-inch sizes in the proportion in which they were found, the following averages are obtained:—

		Grammes.
1st consignment, 1st grade.	Average gross weight about	19
2nd ,,	,, ,, ,,	11
3rd ,,	,, ,, ,,	6
2nd consignment, 1st grade	,, ,, ,,	18
2nd ,,	,, ,, ,,	13
3rd ,,	,, ,, ,,	6

Unfortunately a comparison between the two consignments is complicated by the differences in the initial sizes, the periods of laying, and such differences as there were in the local (weather) conditions of 1902 and 1903. Moreover, the oysters of the first consignment appear to have borne the journey much better than those of the second.

Of the first consignment only four oysters arrived dead, having been accidentally broken in packing, and six days after arrival, when the the oysters were finally laid, no further dead were noticed.

A far heavier mortality was noted in the case of the second consignment, more especially in the 1st and 2nd grades. In the first grade (5-6 cm.) 75 oysters died in the first week, and a further number (57) before the oysters were finally caissed. The second grade (4-5 cm.) appears to have been a sickly lot, and the condition of the samples examined was not satisfactory. Of this grade 277 died within the first week, and a further number (203) before the oysters were finally placed in their caisses. The third grade ($2\frac{1}{2}$-4 cm.) travelled best, the **mortality** only amounting to four.

The following are, therefore, worth very little *as comparisons*, but are decidedly interesting considered as fairly normal results obtainable from the methods of ground layings, and of cultivation in caisses.

Taking the net results of the raisings of each grade at end of 1902-1903 and reducing them to a standard of 1,000 oysters raised, the comparative growth may be thus expressed:—

—	3″.	$2\frac{1}{2}$″.	2″.	$1\frac{1}{2}$″.	1″.
1st Consignment (Ground), 1st Grade, ...	77	368	527	29	-
2nd do. (Caisses), do., ...	10	109	450	427	3
1st Consignment (Ground), 2nd Grade,	14	274	589	*123	-
2nd do. (Caisses), do., ...	-	8	161	639	191
1st Consignment (Ground), 3rd Grade, ...	-	84	506	*410	-
2nd do. (Caisses), do., ...	-	4	227	592	177

The losses on the grades in both consignments were:—

1st grade.	Ground. . . .	544	per thousand laid.
,,	Caisses. . . .	98	,, ,,
2nd grade.	Ground. . .	419	,, ,,
,,	Caisses. . .	126	,, ,,
3rd grade.	Gronnd. . .	743 to 800	,, ,,
,,	Caisses. . .	72	,, ,,

* Including some 1″ oysters

These results do not, however, give a fair index to the amount of growth which may be obtained by the use of caisses. It will have been noticed (see Tables) that the caisse oysters were laid in different proportions, some compartments being more crowded than others. The results of raising from the different compartments will be found on Table XIB., where the numbers at sizes raised have been expressed as parts of 1,000. On the whole it would appear that the growth is inversely to the numbers laid; where the laid sizes of the two consignments are the same, the figures on Tables XIA. and XIB. show that better growth was obtained in some compartments of caisses than in ground layings.

It must be admitted that the growth shown by the 2nd grade (4-5 cm.) Aurays in caisse was unsatisfactory, but it may probably be in great part ascribed to the sickly condition of the oysters when received. (See p. 255.

The examination of the gross and fish weights of similar (raised) sizes of both consignments would show that, in regard to growth of survivors, equally satisfactory results are obtainable from caisses and from ground layings.

The condition of the fish of the caisse oysters of this lot was generally less satisfactory than that found in samples from ground layings, but allowance must be made for the early date of examination of the former, the oysters being obviously out of condition and in some instances still containing spat.

While the growth in caisses depends to a large extent on the numbers laid in each compartment, it is also considerably affected by the location of the caisse. It has been stated* that better growth is made by caisse oysters when they are laid in such a position as to be affected by the current or tide. This theory is apparently borne out by the results attained by two caisses of 3rd grade oysters at Burren. (See Table XIB, Caisses xvii. and xviii.). It was reported in June of 1903 that the oysters in this latter caisse appeared to be subjected to the influence of each ebb and flow of the tide, being thus turned over several times during each 24 hours. The growth attained in caisse xviii. renders it probable that this statement was correct; the figures speak for themselves.

The theory, however, needs further investigation before it can be accepted as correct, and we suspect that great difficulty would be found in selecting exactly that degree of disturbance which is at once favourable in the adduction of food and innocuous to shell growth or not wasteful of the expenditure of nutrition thereby entailed.

The results of the examination of the first consignment at the end of the second season are tabulated (see Tables IX. and X.). As, owing to want of space at Burren, it was not possible to keep separately during the second season the sizes (raised) in each grade, sample lots of 200 of each half inch raised size were, in most instances, taken and laid separately; but the losses in these layings having been excessive, the numbers finally raised for examination are too small to be of much importance. On the whole there is a general and well-marked increase in weights in the layings, but not so much as is noticed in the few oysters of the first consignment laid in caisses during the second season. (See Table IX., Ref. 25c.). These latter made a better fish and the losses (see p. 314) are comparatively trifling when compared with those sustained by the ground layings.

* Hayes, *op. cit.*, p. 9.

TABLES VIII. to XIV.

TABLE

GROUND LAYINGS

AURAY OYSTERS. FIRST CONSIGNMENT.

Reference Number.	Date.	Quality.	Bed.	Total Numbers Laid.	Size.	Average Gross Weight in Grmes.	Date of Raising.	Total Numbers Raised (Living).	Losses, including Dead and Missing.	3″.	Average Gross Weight in Grmes.	Fish No. Examined.
1	19. xii. 01.	Auray, 5-6 cm. (direct).	Arklow, 1 and 1 b.	2,500	2″	17·6		1,189	1,311	10	–	–
							22. xi. 02.	573		10	40·0	–
							28. xi. 02. to 31. xii. 02.	616		–	–	–
2	19. xii. 01.	Auray, 5-6 cm. (direct).	Red Bank, e.	1,000	2″	17·6		657	343	–	–	–
							20. v. 02.	615[a]		–	–	–
							26. ix. 02.	42		–	–	–
3	19. xii. 01.	Auray, 5-6 cm. (direct).	Illaunacraggah, 2 b.	1,200	2″	17·6	15-16. i. 03.	625	575	32	48·4	32
4	19. xii. 01.	Auray, 5-6 cm. (direct).	Clean Flat, 4.	2,000				1,164	836	100	–	–
				1,250	2½″	24·9	20. v. 02.	(200)[b]		–	–	–
				750	2″	17·6	7. vi. 02.	10		–	–	–
							19. vii. 02.	50		–	–	–
							2. ix. 02.	50		–	–	–
							7. x. 02.	1,054		100	46·6	50
5	19. xii. 01.	Auray, 5-6 cm. (direct).	Hynes Deep, 2 b.	2,500				758	1,742	143	–	–
				500	2½″	24·9	20. v. 02.	(200)[b]		–	–	–
				2,000	2″	17·6	20. xi. 02.	463		93	52·5	50
							25. xi. 02.	295		50	–	–
6	19. xii. 01.	Auray, 4-5 cm. (direct).	Arklow, 4.	5,000	1½″	9·2	8. x. 02	1,354	3,646	1	–	–
7	19. xii. 01.	Auray, 4-5 cm. (direct).	Red Bank, b.	3,000	1½″	9·2	12. v. 02.	880[a]	2,120	–	–	–
8	19. xii. 01.	Auray. 4-5 cm. (direct)	Clean Flat, 3.	4,000								
				1,500	2″	17·0	6. x. 02.	2,742	1,258	44	43·2	44
				2,500	1½″	9·2						
9	19. xii. 01.	Auray, 4-5 cm. (direct).	Hynes Deep, 1 b.	5,000				4,353	647	81	–	–
				2,000	2″	17·0	20. v. 02.	(200)[b]		–	–	–
				3,000	1½″	9·2	29. x. 02.	3,590		68	41·9	50
							14. xi. 02.	763		13	–	–
10	19. xii. 01.	Auray, 4-5 (direct).	Illaunacraggah, 1 b.	2,000				847	1,153	–	–	–
				1,060	2″	17·0	20. v. 02.	(200)[b]		–	–	–
				940	1½″	9·2	21–27. i. 03.	847		–	–	–

(a) Not sized. Transferred to Arklow 6. See Ref. No. 17A. (c) Sample 200 (2″) taken from these. See Ref. No. 19.
(b) Put back on same bed after weighing. (d) Sample 200 (2½″) taken from these. See Ref. No. 18.

VIII.

AT BURREN.

Results of Raising at Stock-taking of 1st Year.

Weight	Numbers Raised (Living), with Sizes and Average Weights.														Reference Number.
			Fish Weight.				Fish Weight.				Fish Weight.		Not Sized.		
Average Weight in Grmes	2½".	Average Gross Weight in Grmes.	No. Examined.	Average Weight in Grmes.	2".	Average Gross Weight in Grmes.	No. Examined.	Average Weight in Grmes.	1½".	Average Gross Weight in Grmes.	No. Examined.	Average Weight in Grmes	No.	Average Gross Weight in Grmes	
-	294	-	-	-	777	-	-	-	108	-	-	-	-	-	1
-	150	34·6	50	4·3	305	27·8	50	3·3	108	20·8	50	4·0	-	-	
-	144	-	-	-	472	-	-	-	-	-	-	-	-	-	
-	40	-	-	-	2	-	-	-	-	-	-	-	615	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	615	18·5	
-	40	-	-	-	2	-	-	-	-	-	-	-	-	-	
41	260	40·2	50	4·8	333	28·8	50	3·2	-	-	-	-	-	-	3
-	415	-	-	-	639	-	-	-	-	-	-	-	10	-	4
-	-	-	-	-	-	-	-	-	-	-	-	-	(200)[b]	25·0	
-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	
-	-	-	-	-	50	33·4	25	4·3	-	-	-	-	-	-	
-	5	40·0	5	6·0	45	33·9	45	4·4	-	-	-	-	-	-	
65	410	40·1	50	8·9	544[c]	29·8	50	5·2	-	-	-	-	-	-	
-	400	-	-	-	215	-	-	-	-	-	-	-	-	-	5
70	250[d]	36·2	50	6·1	120[e]	30·5	50	4·4	-	-	-	-	(200)[b]	21·0	
-	150	-	-	-	95	-	-	-	-	-	-	-	-	-	
-	129	28·7	50	3·7	661	22·5	50	2·8	563[f]	17·0	50	2·0	-	-	6
-	-	-	-	-	-	-	-	-	-	-	-	-	880	16·8	7
55	596[g]	34·3	50	4·0	2,102[h]	23·0	50	2·9	-	-	-	-	-	-	8
-	1,196	-	-	-	2,194	-	-	-	582	-	-	-	-	-	9
66	1,291	33·5	50	4·9	1,843	25·1	50	3·7	388[f]	16·5	100	2·2	(200)[b]	19·3	
-	205	-	-	-	351	-	-	-	194	-	-	-	-	-	
-	330	-	-	-	517	-	-	-	-	-	-	-	-	-	10
-	330	37·5	50	5·5	517	28·8	50	3·6	-	-	-	-	(200)[b]	19·0	

(e) Includes 2" and under.
(f) Includes both 1½" and 1".

(g) Sample 200 (2½") taken from these. See Ref. No. 21.
(h) Sample 200 (2") taken from these. See Ref. No. 22.

TABLE

GROUND LAYINGS

AURAY OYSTERS. FIRST CONSIGNMENT.

Reference Number.	Date of Laying.	Quality.	Bed.	Total Numbers Laid.	Size.	Average Gross Weight in Grmes.	Dates of Raising.	Total Numbers Raised (Living).	Losses, including Dead and Missing.	NUMBERS 3″.	Average Gross Weight in Grmes.
11	19. xii. 01.	Auray, $2\frac{1}{2}$–4 cm. (direct).	Arklow, 1 c and d.	3,000	1″ and $1\frac{1}{2}$″*	6·5†	 4. xii. 02. 9. xii. 02.	418 162 256	2,582	- - -	- - -
12	19. xii. 01.	Auray, $2\frac{1}{2}$–4 cm. (direct).	Clean Flat, 2.	13,000	1″ and $1\frac{1}{2}$″*	6·5†	 29. i. 02. 10. iii. 02. 20. v. 02. 5. x. 02.	5,276 600[a] 1,200[a] (400)[b] 3,476	7,724	- - - - -	- - - - -
13	19. xii. 01.	Auray, $2\frac{1}{2}$–4 cm. (direct).	Hynes Deep, 3 a.	6,000	1″ and $1\frac{1}{2}$″*	6·5†	 30. i. 02. 10. iii. 02. 20. v. 02. 11. ii. 03.	2,625 600[a] 1,200[a] (200)[b] 825	3,375	- - - - -	- - - - -
14	19. xii. 01.	Auray, $2\frac{1}{2}$–4 cm. (direct).	Red Bank, a.	5,000	1″ and $1\frac{1}{2}$″*	6·5†	 10. iii. 02. —. v. 02.	2,971 1,300[d] 1,671	2,029	- - -	- - -
15	19. xii. 01.	Auray, $2\frac{1}{2}$–4 cm. (direct).	Illaunacrag-gah, 3 a and b.	12,617	1″ and $1\frac{1}{2}$″*	6·5†	 5. ii. 02. 10. iii. 02. 18. vi. 02. to 4. vii. 02 1[illegible] ii. 03.	2,931 600[f] 1,200[f] 1,040[g] 91	9,686	- - - - -	- - - - -
16	19. xii. 01.	Auray, $2\frac{1}{2}$–4 cm. do. 4–5 „ do 5–6 „ (direct.)	Curtin 1 a, b, c.	2,000 1,000 500 500	 1″ and $1\frac{1}{2}$″* 2″ 2″	 6·5† 17·0 17·6	30. i. 03.	799	1,201	19	44·7
17	19. xii. 01.	Auray, $2\frac{1}{2}$–4 cm. do. 4–5 „ do. 5–6 „ (direct)	Curtin, 2a, b, c.	2,000 1,000 500 500	 $1\frac{1}{2}$″ 2″ 2″	 8·2 17·0 17·6	3. i. 03.	692	1,308	34	44·1
17A	—. v. 02.	Auray, $2\frac{1}{2}$–4 cm. See Ref. No. 14. Auray, 4–5 cm. See Ref. No. 7. Auray, 5–6 cm. See Ref. No. 2. From Red Bank.	Arklow, 6.	3,166 1 671 880 615	 ($1\frac{1}{2}$″ and 1″) ($1\frac{1}{2}$″) (2″)	 - - -	6. x. 02.	890	2,276	6	-

* The consignment of Auray Oysters, $2\frac{1}{2}$–4 cm., see Reference Nos. 11–16, was found on sizing to contain 140, 2″, average gross weight 14·2 grmes.; 9,605, $1\frac{1}{2}$″, average gross weight 8·2 grmes.; and 31,872, 1″, average gross weight 4·6 grmes. These sizes were not kept distinct except in the laying on Curtin 2, Ref. No. 17; the other layings of Auray, $2\frac{1}{2}$–4 cm. consisted (mainly) of $1\frac{1}{2}$″ and 1″ oysters.

† Average gross weight of sample of 200 not sized.

(a) Transferred to caisse. See Ref. Nos. 32 and 32A.

(b) Relaid in same bed after weighing.

VIII.—*continued.*

AT BURREN.

Results of Raising at Stock-taking of 1st Year

RAISED (LIVING), WITH SIZES AND AVERAGE WEIGHTS.

Fish Weight.		2½".	Average Gross Weight in Grmes.	Fish Weight.		2".	Average Gross Weight in Grmes.	Fish Weight.		1½".	Average Gross Weight in Grmes	1".	Average Gross Weight in Grmes.	Reference Number.
No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes			No. Examined	Average Weight in Grmes.					
-	-	56	-	-	-	221	-	-	-	141	-	-	-	11
-	-	48	39·4	-	-	89	27·6	-	-	25	22·0	-	-	
-	-	8	-	-	-	132	-	-	-	116	-	-	-	
-	-	230	-	-	-	1,450	-	-	-	2,996	-	600	-	12
-	-	-	-	-	-	-	-	-	-	-	-	600[a]	-	
-	-	-	-	-	-	-	-	-	-	1,200[a]	-	-	-	
-	-	-	-	-	-	-	-	-	-	(200)[b]	9·5	(200)[b]	6·0	
-	-	230	26·2	-	-	1,450	18·8	-	-	1,796[c]	12·4	-	-	
-	-	110	-	-	-	715	-	-	-	-	-	1,800	-	13
-	-	-	-	-	-	-	-	-	-	-	-	600[a]	-	
-	-	-	-	-	-	-	-	-	-	-	-	1,200[a]	-	
-	-	-	-	-	-	-	-	-	-	-	-	(200)[b]	6·3	
-	-	110	29·0	50	3·5	715	19·0	50	2·2	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	2,271	-	700	-	14
-	-	-	-	-	-	-	-	-		600[d]	-	700[d]	-	
-	-	-	-	-	-	-	-	-	-	1,671[e]	-	-	-	
-	-	14	-	-	-	77	-	-	-	1,940	-	900	-	15
-	-	-	-	-	-	-	-	-	-	300[f]	-	300[f]	-	
-	-	-	-	-	-	-	-	-	-	600[f]	-	600[f]	-	
-	-	-	-	-	-	-	-	-	-	1,040[g]	-	-	-	
-	-	14	39·3	14	2·9	77	23·3	50	2·8	-	-	-	-	
19	5·8	238	35·5	50	3·9	542	25·0	50	3·0	-	-	-	-	16
21	5·3	204	31·6	50	4·4	454	25·6	50	3·6	-	-	-	-	17
-	-	191	-	-	-	542	-	-	-	151	-	-	-	17A

(c) Sample 200 taken from these. See Ref. No. 23.
(d) Transferred to caisse. See Ref. No. 30.
(e) Includes both 1½" and 1". Transferred to Arklow 6. See Ref. No. 17A.
(f) Transferred to caisse. See Ref. No. 31.
(g) Includes 1½" and 1". Transferred to caisse LXXI., LXXII., the contents of which were accidentally mixed with "Whitstable" oysters.

TABL

GROUND LAYINGS AND

AURAY OYSTERS. FIRST CONSIGNMENT (RELAID). Results of

Reference Number.	Date of Laying.	Quality.	Bed.	Total Number Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Total Number Raised (Living).	Losses, including Dead and Missing.
18	—. xii. 02.	Auray, 5-6 cm. Relaid. See Ref. No. 5.	Arklow Newparc.	200	2½″	36·2	6·1	25. vii. 03.	75 [d] (77) [a]	125 [b]
18A	25. vii 03.	Do. From Arklow Newparc.	Caisse XVI., C. Parkmore.	77	(2½″)	–	–	17. ix. 03.	75 [d]	
19	—. xii. 02.	Auray, 5-6 cm. Relaid. See Ref No. 4.	Arklow Newparc.	200	2″	29·8	6·2	25. vii. 03.	21 [d] (44) [c]	179 [b]
19A	25. vii. 03.	Do. From Arklow Newparc.	Parkmore.	44	(2″)	–	–	6. xi. 03	21 [d]	
20	—. xii. 02.	Auray, 4-5 cm. Relaid. See Ref. No. 25.	Arklow Newparc.	200	2½″	33·6	4·9	25. vii. 03.	75 [d] (96) [c]	125 [b]
:0A	25 vii. 03.	Do. From Arklow Newparc	Parkmore.	96	(2½″)	–	–	6. xi. 03.	75 [d]	
21	—. xii. 02.	Auray, 4-5 cm. Relaid. See Ref. No. 8.	Arklow Newparc.	200	2½″	34·3	4·0	25. vii. 03.	49 [d] (64) [c]	151 [b]
21A	25. vii. 03.	Do. From Arklow Newparc.	Parkmore.	64	(2½″)	–	–	6. xi. 03.	49 [d]	
22	—. xii. 02.	Auray, 4-5 cm. Relaid. See Ref. No. 8.	Arklow Newparc.	200	2″	23·0	2·9	25. vii. 03.	91 [d] (134) [c]	109 [b]
22A	25. vii. 03.	Do. From Arklow Newparc.	Parkmore.	134	(2″)	–	–	6. xi. 03.	91 [d]	
23	—. xii. 02.	Auray, 2½-4 cm. Relaid. See Ref. No. 12.	Arklow Newparc.	200	1½″	12·4	–	25. vii. 03.	31 [d] (41) [c]	169 [b]
23A	25. vii. 03.	Do. From Arklow Newparc.	Parkmore.	41	(1½″)	–	–	6. xi. 03.	31 [d]	
24	—. xii. 02.	Auray, 2½-4 cm. Relaid. See Ref. No. 12.	Arklow Pool.	1,450	2″	18·8	–	20. x. 03.	433	1,017
25	29. x. 02 to 14. xi. 02.	Auray, 4-5 cm. Relaid. See Ref. No. 9.	Arklow 20.	1,446	2½″	33·6	4·9	—. xii. 02. 20. xii. 02.	1,100 800 [e] (471) [f]	346 [h]
25A	20. xii. 02.	Auray, 4-5 cm. Relaid. See Ref. No. 25.	Arklow 23.	471	(2½″)	–	–	25. vii. 03.	300 [g]	
25B	25. vii. 03.	Auray, 4-5 cm. Relaid. See Ref. No. 25A.	Caisse XVI., B. on Parkmore.	300	(2½″)	–	–	17. ix. 03.	290	10 [h]
25C	20. xii. 02.	Auray, 4-5 cm. Relaid. See Ref. No. 25.	Caisse on Arklow. XLVI., XLVII., XLVIII.	600 XLVI. 200 XLVII. 200 XLVIII. 200	2½″	–	–	2. x. 03.	521 [j] XLVI. 172 XLVII. 168 XLVIII 181 [j]	86 28 [k] 32 [l] 26

(a) 77 transferred to Caisse XVI., C. See Ref. No. 18A. (b) Total losses from date of laying of sample lots of 200 to final raising and sizing. (c) Nnmbers raised and transferred to Parkmore. See below. (d) Total number raised at final raising and sizing of sample lots of 200. (e) 600 transferred to Caisse XLVI., XLVII., XLVIII., Ref. No. 25C, and 200 transferred to ground. See Ref. No. 20. (f) 471 Relaid, See Ref. No. 25A. (g) 300 not sized,

IX

CAISSES AT BURREN.

Raising at Stock-taking of 2nd Year of Trade Sizes Laid separately.

Number Raised (Living), with Sizes and Average Weights.																
3"	Average Gross Weight in Grmes.	Fish Weight. No. Examined	Fish Weight. Average Weight in Grmes.	2¼"	Average Gross Weight in Grmes.	Fish Weight. No. Examined	Fish Weight. Average Weight in Grmes.	2"	Average Gross Weight in Grmes.	Fish Weight. No. Examined	Fish Weight. Average Weight in Grmes.	1½"	Average Gross Weight in Grmes.	Fish Weight. No. Examined	Fish Weight. Average Weight in Grmes.	Reference Number.
-	-	-	-	65	-	-	-	10	-	-	-	-	-	-	-	18
-	-	-	-	65	50·8	10	8·0	10	43·5	-	-	-	-	-	-	18A
-	-	-	-	5	-	-	-	16	-	-	-	-	-	-	-	19
-	-	-	-	5	-	-	-	16	34·7	10	4·0	-	-	-	-	19A
3	-	-	-	55	-	-	-	17	-	-	-	-	-	-	-	20
3	66·6	-	-	55	46·4	48	5·4	17	37·4	10	4·5	-	-	-	-	20A
1	-	-	-	20	-	-	-	28	-	-	-	-	-	-	-	21
1	-	-	-	20	47·5	20	5·5	28	39·6	20	4·2	-	-	-	-	21A
-	-	-	-	24	-	-	-	61	-	-	-	6	-	-	-	22
-	-	-	-	24	44·8	20	5·5	61	32·8	50	4·1	6	20·0	-	-	22A
-	-	-	-	-	-	-	-	17	-	-	-	14	-	-	-	23
-	-	-	-	-	-	-	-	17	26·8	10	3·0	14	21·8	10	2·0	23A
8	52·5	-	-	140	42·2	50	6·3	285	30·3	50	3·7	-	-	-	-	24
																25
																25A
6	51·0	-	-	143	46·0	50	6·3	139	35·2	50	4·7	2	-	-	-	25B
37	-	-	-	295	-	-	-	163	-	-	-	1^{m}	-	-	-	25C
6	57·5	-	-	93	46·8	25	8·2	72	35·8	10	6·5	1^{m}	-	-	-	
17	58·8	-	-	95	48·7	25	7·6	56	37·1	10	6·0	-	-	-	-	
14	51·8	-	-	107	48·1	50	7·1	35	36·4	10	6·5	-	-	-	-	

...nsferred to Caisse XVI., B. See Ref. No. 25B. (h) Total losses 10, including 8 dead shells removed at inspections ...d 2 missing. (j) Includes 25 not sized removed for examination 1. vi. 03, and an excess of 7 over number laid. ... 28 = 27 dead removed and 1 missing. (l) 32 = 30 dead removed and 2 missing. (m) Not sized. (n) Total loss ...ing time of laying on ground.

TABLE

GROUND LAYINGS

AURAY OYSTERS. FIRST CONSIGNMENT (RELAID). Results of

Reference Number.	Date.	Quality.	Bed.	Total Numbers Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Total Number Raised. (Living).	Losses, including Dead and Missing.
				2,228					1,328	900
26	25. xi. 02 to 16. i. 03.	Auray 5-6 cm. (Relaid).	Arklow 25.	604	2½″	34·6 to 40·2	4·3 to 4·8	15. x. 03. 16. x. 03.	1,257 71	
	25. ix. 03.	do.	„	40	2½″	-	-			
	—. xii. 02. to 27. i. 03.	Auray 4-5. cm. (Relaid).	„	705	2½″	28·7 to 37·5	3·7 to 5·5			
	—. xii. 02 to 11. ii. 03.	Auray 2½-4. cm. (Relaid).	,	346	2½″	26·2 to 39·4	3·5			
	6. x. 02 to 30. i. 03.	Auray 2½-4, 4-5 and 5-6 cm. (Relaid).	„	533	2½″	31·6 to 35·5	3·4 to 4·9			
				8,696 Auray. 912 *Arcachon.*				20. x. 03.	3,705	5,903
27	22. xi. 02 to 16. i. 03.	Auray 5-6 cm. (Relaid).	Arklow 12e.	1,469	2″	27·8 to 30·5	3·2 to 5·2			
	25. ix. 03.	do.	„	2	2″	-	-			
	6. x. 02 to 27. i. 03.	Auray 4-5 cm. (Relaid).	„	6,074	2″	22·5 to 28·8	2·8 to 3·7			
	4. xii. 02. to 12. ii. 03	Auray 2½-4 cm. (Relaid).	„	913	2″	19·0 to 27·6	2·2 to 2·8			
	—. xii. 02 to 30. i. 03.	Auray 2½-4, 4-5, and 5-6 cm. (Relaid).	„	1,238	2″	25·0 to 25·6	3·0 to 3·6			
		Arcachon 1st and 2nd qualities. (Relaid).	„	912	2″	(47·5)	(5·9)			
				1,941 Auray. 47 *Kentish Knock.*				20. x. 03.	130	1,858
28	—. xii. 02.	Auray 5-6 cm. (Relaid).	Arklow 12d.	58	1½″	20·8	4·0			
	—. xii. 02.	Auray 4-5 cm. (Relaid).	„	995	1½″ and under	16·5 to 17·0	2·0 to 2·2			
	5. x. 02 to 9 xii. 02.	Auray 2½-4 cm. (Relaid).	„	737	1½″	12·4 to 22·0	-			
	—. xii. 02.	Auray 2½-4, 4-5 and 5-6 cm. (Relaid).	„	151	1½″	-	·			
		Kentish Knock. (Relaid).	„	47	3″, 2½″ and 2″	-	-			

IX.—*continued.*

AT BURREN.

Raising at Stock-taking of 2nd Year of Mixed Trade Sizes.

Number raised (Living), with Sizes and Average Weights.																Reference Number.
3″	Average Gross Weight in Grmes.	Fish Weight.		2½″	Average Gross Weight in Grmes.	Fish Weight.		2″	Average Gross Weight in Grmes.	Fish Weight.		1½″	Average Gross Weight in Grmes.	Fish Weight.		
		No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes.	
[illegible]	–	–	–	838	–	–	–	389								26
[illegible] 3	66·6 –	50 –	7·8 –	794 44	49·4 –	50 –	6·0 –	365 24	35·6 –	50 –	4·3 –	– –	– –	– –	– –	
[illegible]	–	–	–	552	43·7	50	6·6	2,689	32·0	49	4·8	464	21·8	50	2·8	27
–	–	–	–	15	45·0	–	–	70	28·2	10	5·3	45	17·8	10	3·0	28

Table X

CAISSES AND GROUND LAYINGS AT BURREN

Argus Oysters. First Consignment. Results of Raising from Caisses at Stock-taking of 1st Year and from Caisses and Ground Layings at Stock-taking of 2nd Year

Reference Number	Date of Laying	Quality	Caisse or Bed	Total Number Laid	Size	Average Gross Weight in Grams	Average Fish Weight in Grams	Date of Raising	Total Numbers Raised (Gross)	Losses, including Dead and Missing	2"	Average Gross Weight in Grams	2½"	Average Gross Weight in Grams	Fish Weight: No. Examined	Fish Weight: Average Weight in Grams	3"	Average Gross Weight in Grams	Fish Weight: No. Examined	Fish Weight: Average Weight in Grams	3½"	Average Gross Weight in Grams	Fish Weight: No. Examined	Fish Weight: Average Weight in Grams	4"	Average Gross Weight in Grams	Fish Weight: No. Examined	Fish Weight: Average Weight in Grams	Reference Number
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table XIa.

Auray Oysters. First Consignment at Burren.

Table showing the Total Losses and relative Growth at the end of the 1st Year of the Oysters when laid on different parts of the Beds.

Date of Laying.	Where Laid.	Quality.	No.	Size.	Date of Raising.	Total No. Raised (Living).	Numbers, at Sizes, of Oysters Raised (Living), expressed as parts of One Thousand.					Loss per Thousand on No. Laid.
							3″.	2½″.	2″.	1½″.	1″.	
19. 12. 01.	Ground. Arklow, 1 and 1 b.	Auray, 5-6 cm. (direct).	2,500	2″	22. 11. 02. to 31. 12. 02.	1,189	8	247	654	91	-	524·4
19. 12. 01.	Ground. Illaunacraggah, 2 b.	Auray, 5-6 cm. (direct).	1,200	2″	15-16. 1. 03.	625	51	416	533	-	-	479·2
19. 12. 01.	Ground. Clean Flat, 4.	Auray, 5-6 cm. (direct).	2,000 1,250 750	 2½″ 2″	7. 10. 02.	1,164	86	356	549	9	-	418·0
19. 12. 01.	Ground. Hynes Deep, 2 b.	Auray, 5-6 cm. (direct).	2,500 500 2,000	 2½″ 2″	20-25. 11. 02.	758	189	528	284	-	-	696·8
19. 12. 01.	Ground. Arklow, 4.	Auray, 4-5 cm. (direct).	5,000	1½″	8. 10. 02.	1,354	1	95	488	416	-	729·2
19. 12. 01.	Ground. Clean Flat, 3.	Auray, 4-5 cm. (direct).	4,000 1,500 2,500	 2″ 1½″	6. 10. 02.	2,742	16	217	767	-	-	314·5
19. 12. 01.	Ground. Hynes Deep, 1 b.	Auray, 4-5 cm. (direct).	5,000 2,000 3,000	 2″ 1½″	29. 10. 02 to 14. 11. 02.	4,353	19	344	504	134	-	129·4
19. 12. 01.	Ground. Illaunacraggah, 1 b.	Auray, 4-5 cm. (direct).	2,000 1,060 940	 2″ 1½″	24-27. 1. 03.	847	-	390	610	-	-	576·5
19. 12. 01.	Ground. Arklow, 1 c and d.	Auray, 2½-4 cm. (direct).	3,000	†1½″& 1″	4-9. 12. 02.	418	-	134	529	337	-	860·7
19. 12. 01.	Ground. Clean Flat, 2.	Auray, 2½-4 cm. (direct).	*11,200	†1½″& 1″	5. 10. 02.	3,476	-	66	417	517	-	689·6
19. 12. 01.	Ground. Hynes Deep, 3 a.	Auray, 2½-4 cm. (direct).	*4,200	†1½″& 1″	11. 2. 03.	825	-	133	867	-	-	803·6
19. 12. 01.	Ground. Illaunacraggah, 3 a and b.	Auray, 2½-4 cm. (direct).	*10,817	†1½″& 1″	18. 6. 02 to 12. 2. 03.	1,131	-	12	68	920	-	895·4

* Exclusive of oysters transferred in January, February and March, 1902, to Caisses.

† See note (*) on Table VIII. as to sizes of these oysters.

Table XIb.

Auray Oysters. Second Consignment at Burren.

Table showing the Total Losses and relative Growth of the Oysters when laid in different proportions in Caisses and on different parts of the Beds.

Date of Laying.	Caisse and Division.		Position on Bed.	Quality.	No.	Size.	Date of Raising.	Total No. Raised (Living).	Numbers at Sizes of Oysters Raised (Living), expressed as parts of One Thousand. 3″	2½″	2″	1½″	1″	Loss per Thousand on No. Laid.
22. 4. 03.	IX.	A.	Parkmore.	Auray, 5-6 cm. (direct).	200	1½″	11. 9. 03.	188	–	21	356	585	37	60·0
		B.			400			376	–	3	309	660	29	60·0
		C.			600			557	–	2	329	668	2	71·7
23. 4. 03.	X.	A.	Arklow 5.	Auray, 5-6 cm. (direct).	200	1½″	29. 9. 03.	163	–	178	742	80	–	185·0
		B.			400			361	–	172	629	199	–	97·5
		C.			600			556	–	121	629	250	–	73·3
23. 4. 03.	XI.	A.	Hynes Deep 4.	Auray, 5-6 cm. (direct).	563	1½″	17. 9. 03.	424	–	113	601	285	–	246·9
		B.			1,125			1,011	–	19	500	481	–	101·3
		C.			1,680			1,545 [a]	–	13	334	653	–	82·7
18. 4. 03.	II.	A.	Arklow.	Auray, 5-6 cm. (direct).	160	2″	29. 9. 03.	140	64	564	350	21	–	125·0
		B.			319			299 [b]	80	435	448	37	–	65·8
		C.			478			457 [c]	63	444	466	26	–	56·5
23. 4. 03.	XIII.	A.	Parkmore.	Auray, 4-5 cm. (direct).	623	1½″	11. 9. 03.	539 [d]	–	2	245	716	37	150·9
		B.			1,246			1,093	–	–	33	820	147	122·8
		C.			1,870			1,637 [e]	–	–	24	887	89	129·9
23. 4. 03.	XIV.	A.	Arklow.	Auray, 4-5 cm. (direct).	612	1½″	30. 9. 03.	550 [f]	–	49	582	358	11	104·6
		B.			1,224			1,125 [g]	–	25	332	621	22	84·2
		C.			1,836			1,650 [h]	–	6	266	706	22	112·7
18. 4. 03.	I.	A.	Parkmore.	Auray, 4-5 cm. (direct).	356	1′	17. 9. 03.	303	–	–	20	502	479	148·9
		B.			712			608	–	–	8	396	595	146·1
		C.			1,069			886 [i]	–	–	5	201	795	171·2
28. 4. 03.	XVII.	A.	Parkmore.	Auray, 2½-4 cm. (direct).	400	1″	17. 9. 03.	377	–	–	406	541	53	57·5
		B.			800			747	–	–	118	653	229	66·3
		C.			1,200			1,150	–	–	111	641	248	41·7
29. 4. 03.	XVIII.	A.	Parkmore.	Anray, 2½-4 cm. (direct).	400	1″	2. 10. 03.	354	–	–	579	381	40	57·5
		B.			800			737	–	8	368	582	52	78·8
		C.			1,200			1,074	–	7	359	584	50	105·0
28. 4. 03.	XIX	A.	Arklow 5.	Auray, 2½-4 cm. (direct).	736	1″	29. 9. 03.	660	–	9	265	639	86	103·3
		B.			1,472			1,377	–	3	192	604	200	64·5
		C.			2,208			2,120	–	2	96	547	354	39·9
28. 4. 03.	XVI.	A.	Parkmore.	Auray, 2½-4 cm. (direct).	910	1½″	17. 9. 03.	805	–	12	333	655	–	115·4

[a] Includes an excess of 4 oysters. The oysters in this Division were not turned over when inspected.
[b] Includes an excess of 1 oyster. [c] Includes an excess of 6 oysters. [d] Includes an excess of 10 oysters.
[e] Includes an excess of 10 oysters. [f] Includes an excess of 2 oysters. [g] Includes an excess of 4 oysters.
[h] Includes an excess of 21 oysters. The oysters in this Division were not turned over when inspected. [i] The oysters in this Division were not turned over when inspected.

Table XIc.

Auray Oysters at Ballynakill. Summary showing Total Losses and relative Growth.

Date of Laying.	How Laid.	Quality.	Number.	Size.	Date of Raising.	Total Number Raised (Living).	Numbers at Sizes of Oysters Raised (Living), expressed as parts of One Thousand.					Losses.				
												Dead Shells removed at Inspections at—		Total Number of Dead Shells removed.	Number of Oysters Missing at Final Count.	Total Losses, including Dead and Missing.
							3″	2½″	2″	1½″	1″	Ballynakill. — Loss per Thousand on Number Laid.	Ardfry. — Loss per Thousand on Number Laid.	Loss per Thousand on Number Laid.	Loss per Thousand on Number Laid.	Loss per Thousand on Number Laid.
10–28. 4. 03.	Caisses.	Auray, 5–6 cm. (direct).	5,555	1½″	16. 3. 04 to 2. 4. 04.	4,484	–	55	385	559	–	101·0	43·4	144·4	48·4	192·8
10. 4. 03.	„	do.	1,007	2″	18. 3. 04.	682	21	422	557	–	–	57·6	22·8	80·4	242·3	322·7
10–28. 4. 03.	Caisses.	Auray, 4–5 cm (direct).	7,103	1½″	18. 3. 04 to 12. 4. 04.	5,866 [a]	–	42	353	605	–	137·8	53·1	190·9	0	190·9
11. 4. 03.	„	do.	1,530	1″	18. 3. 04 to 1. 4. 04.	1,064 [b]	–	–	110	890	–	249·7	58·8	308·5	0	308·5
9. 4. 03.	„	do.	123	2″	1. 4. 04.	90	–	322	589	89	–	203·3	56·9	260·2	8·1	268·3
25–26. 6. 03.	Caisses.	Auray, 3–4 cm. (direct).	7,911	1″	13. 2. 04 to 12. 4. 04.	5,417 [c]	–	–	35	463	501	275·6	43·2	318·8	0	318·8
25. 6. 03.	„	do.	655	1½″	12. 4. 04.	392 [d]	–	23	383	594	–	342·0	76·3	418·3	0	418·3
25. 6. 03.	„	do.	567	Under 1″	12. 4. 04.	146	–	–	27	521	452	225·7	22·9	248·7	493·8	742·5

[a] Includes an excess of 119. [b] Includes an excess of 6. [c] Includes an excess of 28. [d] Includes an excess of 11.

TABLES XII. TO XIV.

GROUND LAYINGS

ARCACHON OYSTERS. FIRST CONSIGNMENT. Results

Reference Number.	Date.	Quality.	Bed.	Total Numbers Laid.	Size.	Average Gross Weight in Grmes.	Date of Raising.	Total Numbers Raised (Living).	Losses including Dead and Missing.
								5,421[a]	
1	27. iii. 02.	Arcachon, 1st Quality, (direct).	Clean Flat, 1 West.	7,350	2½″	37·0 from sample of 50.	8. iv. 02.	100*	
							7. vi. 02.	10[b]	
							2. ix. 02.	49	
							24-27. x. 02.	4,692	
							19. xi. 02.	454[c]	3,668[e]
							25. vi. 03.	116[d]	
								2,801	
2	27. iii. 02.	Arcachon, 1st Quality, (direct).	Clean Flat, 1 East.	4,540	2″	32·0 from sample of 50.	8. iv. 02.	100*	
							24-27. x. 02.	2,701	
								1,055	
3	27. iii. 02.	Arcachon, 2nd Quality, (direct).	Arklow 4, East End.	3,275	2½″	32·0 from sample of 50.	8. iv. 02.	100*	2,220
							16. x. 02.	955	
								3,779	
4	27. iii. 02.	Arcachon, 2nd Quality, (direct).	Hynes Deep 3 b.	6,600	2″	24·0 from sample of 50.	8. iv. 02.	100*	2,821
							21-25. xi. 02.	3,679	

a This total includes some 1st quality laid as 2″. See notes "*c*" and "*d*."
b Not sized or weighed.
c These (454) were taken from Clean Flat, East and West, and include Arcachons, 1st quality, 2½″ and 2″ (laid sizes).
d These (116) were raised after the Clean Flat had been harrowed,
* For further history, see Table XXIII.

XII.

AT BURREN.

of Raising at Stock-taking of 1st Year.

Numbers Raised (Living), with Sizes and Average Weights.												
3″	Average Gross Weight in Grmes.	Fish Weight.		2½″	Average Gross Weight in Grmes.	Fish Weight.		2″	Average Gross Weight in Grmes.	Fish Weight.		Reference Number.
		No. Exa-mined.	Average Weight in Grmes.			No. Exa-mined.	Average Weight in Grmes.			No. Exa-mined.	Average Weight in Grmes.	
256	-	-	-	2,640	-	-	-	2,515	-	-	-	1
-	-	-	-	100	35·3	10	3·4	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	47	52·0	46	5·9	2	42·5	2	5·0	
229	62·5	50	8·1	2,207	52·4	50	6·0	2,265	42·1	50	4·0	
36	-	-	-	211 f	-	-	-	207	-	-	-	
-	-	-	-	75	-	-	-	41	-	-	-	
40	-	-	-	742	-	-	-	2,019	-	-	-	2
-	-	-	-	-	-	-	-	100	31·3	10	3·1	
40	61·3	-	-	742	49·8	50	5·6	1,919 g	39·3	50	3·6	
8	-	-	-	292	-	-	-	755	-	-	-	3
-	-	-	-	100	29·8	10	3·5	-	-	-	-	
8	59·4	-	-	192 f	47·5	50	5·9	755	38·5	50	3·9	
182	-	-	-	1,629	-	-	-	1,968	-	-	-	4
-	-	-	-	-	-	-	-	100	24·4	10	2·7	
182	55·5	50	7·2	1,629	47·4	50	6·2	1,868 h	35·5	50	4·2	

e Total losses of Arcachon 1st quality, laid as 2½″ and 2″.
f Relaid on Arklow 25. See Ref. No. 7.
g Includes both 2″ and under. The sample 200 "2″," see Ref. No. 5, were taken from this lot.
h Includes both 2″ and under.

TABLE

CAISSE AND GROUND

ARCACHON OYSTERS. FIRST CONSIGNMENT (RELAID).

Reference Number.	Date of Laying.	Quality.	Bed.	Total Number Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Total Numbers Raised (Living).	Losses, including Dead and Missing.
5	—. xii. 02.	Arcachon, 1st Quality, Relaid. See Ref. No. 2.	Arklow Newparc.	200	2″ and under.	39·3	3·6		52 [a]	
								25. vii. 03.	(79) [b]	148 [c]
5A	25. vii. 03.	do. See above.	Parkmore.	(79)	(2″ and under.)	-	-	6. xi. 03.	52	
6	—. xii. 02.	Arcachon, 1st and 2nd Qualities, Relaid. See Ref. No. 8.	Arklow Newparc.	200	2½″	-	-		26 [a]	
								25. vii. 03.	(38) [b]	174 [c]
5A		do. See above.	Parkmore.	(38)	(2½″)	-	-	6. xi. 03.	26	
7	24. x. 02 to 19. xi. 02.	Arcachon, 1st Quality, Relaid. See Ref. Nos. 1, 2.	Arklow, 25.	739 246	3″	61·3 to 62·5	-	16. x. 03.	210	29
	16. x. 02 to 25. xi. 02.	Arcachon, 2nd Quality, Relaid. See Ref. Nos. 3, 4.	do.	140	3″	55·6 to 59·4	-			
	Do.	Arcachon, 1st and 2nd Qualities, Relaid. See Ref. Nos. 1 and 3.	do.	353	2½″	-	-			
8	24–27. x. 02.	Arcachon, 1st Quality, Relaid. See Ref. Nos. 1, 2.	Arklow, 19.	4,503 2,849	2½″	49·8 to 52·4	5·6 to 6·0	—. xii. 02. 6–9. x. 03.	2,810 200 [d] 2,610	1,693
	25. vi. 03.	do. See Ref. No. 1.	do.	75	2½″	-	-			
	21–25. xi. 02.	Arcachon, 2nd Quality, Relaid. See Ref. No. 4.	do.	1,579	2½″	47·4	6·2			
9	24–27. x. 02.	Arcachon, 1st Quality, Relaid. See Ref. Nos. 1, 2.	Arklow, 19.	5,743 Arcachon. 540 *I. of Wight.* 3,884	- 2″ and under.	- 39·3 to 42·1	- 3·6 to 4·0	- 13. xii. 02. 6–9. x. 03.	3,240 600 [e] 2,540 [f]	3,043
	25. vi. 03.	do. See Ref. No. 2.	do.	41	2″	-	-			
	21–25. xi. 02.	Arcachon, 2nd Quality, Relaid. See Ref. No. 4.	do.	1,818	2″	35·5	4·2			
	5. xi. 02.	*I. of Wight.*	do.	640 { 26 253 261	3″ 2½″ 2″	59·6 51·4 40·8	6·2 5·6 3·8			
10	13. xii. 02.	Arcachon, 1st and 2nd Qualities, Relaid. See Ref. No. 9.	Caisse, X., XI., XII., on Arklow.	600 X. 200 XI. 200 XII. 200	2″ and under.	-	-	15. ix. 03.	407 X. 137 XI. 141 XII. 129	193

a Total number raised at final Raising and Sizing, Nov., 03.
b Not sized. Removed to Parkmore.
c Total losses from date of laying, Dec., 02, to date of final raising, Nov., 03.

XIII.

LAYINGS AT BURREN.

Results of Raising at Stock-taking of 2nd Year

Numbers Raised (Living), with Sizes and Average Weights.																Reference Number.
				Fish Weight.				Fish Weight.				Fish Weight.				
3½"	Average Gross Weight in Grmes.	3"	Average Gross Weight in Grmes.	No. Examined	Average Weight in Grmes.	2½"	Average Gross Weight in Grmes.	No. Examined	Average Weight in Grmes.	2"	Average Gross Weight in Grmes	No. Examined	Average Weight in Grmes.	1½"	Average Gross Weight in Grmes.	
-	-	-	-	-		11	-	-	-	41	-	-	-	-	-	5
-	-	-	-	-	-	11	51·8	10	5·5	41	43·5	40	4·0	-	-	5A
-	-	2	-	-	-	22	-	-	-	2	-	-	-	-	-	6
-	-	2	-	-	-	22	58·6	20	6·8	2	-	-	-	-	-	6A
5	100·0	140	76·6	50	8·1	65	66·7	50	6·7	-	-	-	-	-	-	7
-	-	26	-	-	-	1,735	-	-	-	849	-	-	-	-	-	8
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	26	76·9	-	-	1,735	57·5	50	6·5	849	46·3	49	5·0	-	-	
-	-	13	-	-	-	251	-	-	-	2,259	-	-	-	117	-	9
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	13	73·1	-	-	251	55·0	49	6·6	2,259	43·1	50	4·6	117 [f]	27·3	
-	-	5	-	-	-	99	-	-	-	276	-	-	-	27	-	10
-	-	1	50·0	-	-	33	56·1	-	-	95	44·7	-	-	8	30·0	
-	-	4	61·3	-	-	45	57·6	23	8·7	80	44·4	-	-	12	29·6	
-	-	-	-	-	-	21	60·7	-	-	101	45·8	47	5·5	7	32·8	

d Sample of 200, not sized, taken from bed and laid. See Ref. No. 6.
e Not sized. Removed to caisse X., XI., XII. See Ref. No. 10.
f Including both spat detached from the shells, and oysters of under 2".

TABLE XIV

CAGES EXPERIMENTS AT BURRAN(?)

ARCACHON OYSTERS. SECOND CONSIGNMENT. Results of Rearing at Stock-taking of 2nd Year

Date of Laying.	Quality.	Station Number.	Position on Beds.	Total No. of Oysters in Cages and in each Division of Cages.	Size.	Average Gross Weight in Grms.	Average Fish Weight in Grms.	Date of Taking.	Total Number taken through from Cages, and from each Division of Cages.	Total Losses: Total Shells Recovered.	Total Losses: Number Missing or Disappeared.	Surviving Oysters (remaining columns 13–26)
1	2	3	4	5	6	7	8	9	10	11	12	13–26
[illegible]	Arcachon (Green) 1st Quality	VI.	Bannerw[illegible]	1300 / A. [illegible] B. [illegible] C. [illegible]	2"	[illegible] from sample of 200	[illegible] from sample of [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Arcachon (Green) 1st Quality	VII.	Ardrew	1300 / A. [illegible] B. [illegible] C. [illegible]	2"	As above.	As above.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Arcachon (Green) 1st Quality	VIII.	Kyles Bute(?)	1300 / A. [illegible] B. [illegible] C. [illegible]	2"	As above.	As above.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Arcachon (Green) 1st Quality	XV	Parkmore(?)	[illegible] Oysters divided between the two divisions of Cages.	2½"	[illegible] from sample of [illegible]	[illegible] from sample of [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Arcachon (Green) 2nd Quality	[illegible]	Ardrew(?)	1300 / A. [illegible] B. [illegible] C. [illegible]	2"	[illegible] from sample of 200	[illegible] from sample of [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Arcachon (Green) 2nd Quality	IV	Parkmore(?)	1300 / A. [illegible] B. [illegible] C. [illegible]	2"	As above.	As above.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Arcachon (Green) 2nd Quality	V	Kyles Bute(?)	1300 / A. [illegible] B. [illegible] C. [illegible]	2"	As above.	As above.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Arcachon (Green) 2nd Quality	XIII.	Ardrew(?)	[illegible] / A. [illegible] B. [illegible] C. [illegible]	1½"	[illegible] from sample of 200	[illegible] from sample of [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* This includes [illegible] Arcachon 1st Quality. [illegible]

† The [illegible]

iii.—*ENGLISH AND DUTCH.*

Tables XV to XXII.

The varieties of these classes under observation at Burren were so-called "Whitstable natives," Falmouths, oysters from an alleged natural bed near the Isle of Wight, and Dutch. For convenience the "Whitstables" and Dutch are treated together.

Kentish Knock and Dutch.—The "Whitstable natives" were sold as such, but were delivered as "Kentish Knock," which latter appears to be their proper designation. The prices were:

Kentish Knock, £2 5*s.* 6*d.* per tub of 2,300, or £1 0*s.* 0*d.* per 1,000
Dutch . . . . £1 8*s.* 0*d.* per 1,000

These prices are free on rail or steamer at London. The oysters arrived at Burren in May and April, of 1902, and on resizing into half-inch sizes, it appeared that over 50% of the "Whitstables" were small ($1\frac{1}{2}''$ or under), while about 66% of the Dutch measured $2\frac{1}{2}''$.

They were raised for examination in the winter of the same year, 1902, the total losses during their period of laying being:

"Whitstables" . . . . . . 207 per thousand laid.
Dutch . . . . 301 ,, ,, ,,

Where the laid sizes of the two qualities were the same, the "Whitstables" showed a better growth. The comparative growth may be thus expressed—for every 1,000 $2\frac{1}{2}''$ (laid size) "Whitstables" raised at the end of the season 162 measured 3″ or over, while a similar raising of Dutch did not show more than 9 3″ or over; similarly 2″ "Whitstables" relaid gave 482 $2\frac{1}{2}''$, or over, per thousand raised against 24 in the case of a similar laying of Dutch.

It is not possible to calculate exactly the proportion of the smaller Whitstables which showed growth, as the laying included both $1\frac{1}{2}''$ and 1″ oysters, but the lowest estimation would be about 480 per thousand raised. An examination of the weights of the fish of both varieties is somewhat in favour of the Dutch, and their percentage of marketable oysters available at the end of the season is slightly higher, being 13% as against 11% for the Whitstables.

The condition of the "fish" of the marketable oysters was satisfactory in both varieties, the "fat, or very fat" being 80% in the Dutch* and 76% in the "Whitstables." In the second season the number of Dutch and Whitstables available for relaying was small, and owing to various causes (shifting of sand, &c.), very heavy losses were incurred, and the numbers finally raised were not sufficient to serve as a basis for any conclusion as to the merits of the two qualities.

The actual losses in the second year were:—For Dutch, 739 per thousand laid; for Whitstables, 808 per thousand laid.

Taking into consideration the prices, relative growth, and relative sizes when laid the Whitstables appear to promise best. Certainly in regard to growth the west coast appears to suit them well.

Isle of Wights.—The consignment from the Isle of Wight (alleged natural bed) was obtained principally with a view to increasing the stock at Burren for spatting purposes, so not much importance was attached to the exact *locus* of origin. However, an idea of the value of these oysters for relaying may be gathered from Tables XIX. and XX., where the results of raising them at the end of the first and second seasons respectively are given.

The oysters were purchased in January, 1902, and were raised after a period of laying of from 11 to 12 months; their losses during the first season, which amounted to 463 per thousand laid, do not compare unfavourably with those of the Whitstables and Dutch (*v. supra*) which

* In the matter of gross weight the Dutch do not come up to the Zealand standard of 70 to 80 grm., but would be classed as "doubtfuls," 55 to 70 grm. See Hoek, *op. cit.*, cap. iv.

were laid for from 6 to 9 months, but several layings of Isle of Wights could not be included, as they were accidentally mixed with another laying when being raised.

The price of Isle of Wights was 25*s.* per thousand (1,000), delivered at the beds; in cost they are midway between the Whitstables and Dutch, or about equal to the latter after counting cost of delivery.

In size they approximate most closely to Tralees, but are deeper and distinct in form, the shells clean with a distinct pink tinge on the round shell. About 66% of the oysters measured $2\frac{1}{2}''$ or over on arrival.

Though it is somewhat misleading to compare their growth with that of the Whitstables and Dutch it would seem that these latter are considerably inferior in this respect.

The fish-weights of the Isle of Wights were, on the whole, small as compared with the gross weights, and were inferior to those of Tralee or Clarenbridge oysters of the same size. The condition of the fish was unsatisfactory except in two layings (Nos. 3 and 4, Table XIX.), where the proportion of fat oysters in the samples examined was 80 per cent.; in the other layings the proportion of fat oysters was very low, from 13 to 25 per cent.

In the second season the losses amounted to 748 per thousand laid, and it is probable that, as with the Falmouths, the survivors do not represent a fair growth; the condition of the fish was very poor, from 16 to 22% only being classed as fat.

Falmouths.—These oysters (see Table XVII.) were obtained direct from Falmouth and arrived at Burren on 3rd May, 1902. The price was 13*s.* per thousand f.o.b. at Falmouth. The natural bed at Falmouth appears to be very prolific, and the oysters are of good table quality in regard to size and shape of shell and size of fish; but their value is considerably reduced by the green discolouration present in a large proportion of them. The greenness is quite distinct from that of the gills of Marennes and Essex oysters, which is due to the storing up of a colouring matter derived from a diatom. In the Falmouth oysters the green colour may extend all over the fish, and is in fact due to excess of copper derived from copper pollution of the beds.

Attention has been paid to this subject by Thorpe* and by Herdman and Boyce.† The last-named observers state that while a white Whitstable "native" contains only 0·4 milligrammes of copper, a very green Falmouth may contain as much as 3·52 milligrammes. It appears that an oyster even so heavily charged with copper is, if nasty, not unwholesome, but the British consumer will not eat it, and extends his distrust even to the diatom-coloured oysters from some of the Essex beds. It is customary at Falmouth to relay these green oysters in places where they are not exposed to copper pollution, and in oysters so relaid we have found only a small percentage which showed any obvious green colour. We understand that the oysters have been extensively relaid on other English beds with a view to the elimination of the colour, but with what result we do not know. The only definite statement as to the period necessary for elimination of the colour which we have been able to find is that of Mr. Pennell,‡ Inspector of Fisheries to the Board of Trade. His statement that six months' isolation is sufficient appears to have been made on the authority of others, and may possibly have been true for the localities to which it refers. Our own experience is different. Of a consignment received in May, 1902, 50 oysters examined in July contained 6% "very green," 32% "pale green," and 62% "not green." Another sample (369) examined in October and November of the same year gave 6% "very green," 8% "moderate green," 9% "pale green," and 77% "not green." A final sample (159) examined in October of the following year (1903) showed 6% "pale green" and 94% "not green." While it is possible that the greenness of the last sample may have been due to malnutrition (see Herdman and Boyce, *op. cit.*, p. 18), as the oysters found green were in poor condition, it is probable that it was really due to failure to eliminate the excess of copper, since no other

* 24th Ann. Rep. L.G.B. (England), 1894-5 [C.—8214], 1896.
† Oysters and Disease. Lancashire Sea-Fisheries Memoir, No. 1, 1899.
‡ *Op. cit.*, p. 12.

green discolouration has been met with in any oysters under our observation.*

If the greenness found in the last sample is really due, as we suppose, to copper, it would appear that 16 months' isolation from sources of this form of pollution is not sufficient to wholly eliminate its effects, or, in fact, to give the oysters a high marketable value, since 1% of green oysters would be quite enough to destroy the reputation of the whole. Certainly six months' isolation proved insufficient to permit of the oysters being offered with a warranty, and as it will be found that our experiments tend to show that the profit of relaying depends largely on the possibility of disposing of stock after not more than a season's cultivation, we consider that Falmouths are not to be recommended as the raw material of first grade ware. Since, however, there is a certain demand for low-priced oysters of good quality, relaid Falmouths sold as such may yield a margin of profit worth considering. Sold, as they have been to our knowledge, under a fancy name without statement of first origin, they do not seem likely to improve the business of the seller.

From the results of raising the consignment at the end of the first season (see Table XVII.) it would appear that the growth of the oysters was somewhat less than that of the Whitstables and Isle of Wights, but superior to that of the Dutch.

The weight of the fish was small compared with the gross weight and the number of possibly marketable oysters at the end of the season was very low; the condition of the fish was fairly satisfactory. The loss during the first season was 269 per thousand laid, which is thus less than that of the Dutch and slightly heavier than that of the Whitstables, but owing to the miscarriage of a report from Burren they were left dumped on unfavourable ground for about a month, and may well have been prejudiced in growth by that circumstance, and by the disturbance in full period of growth which was necessary when the report finally came to hand.

During the second season (see Table XVIII.) the losses amounted to 698 per thousand laid, and it is probable that the survivors do not represent a normal increase in size or in gross and fish weights.

To some extent the results of the Burren trial may have been affected by the lateness of date (May) of importation. It is, we believe, best to import oysters only in the months from November to March, inclusive. Growth of shell commonly commences in April, and is generally finished for the season by November, and no doubt the period mentioned above is the best for travelling oysters, provided there is no frost at the time of transport or before the oysters can be disposed of in their permanent quarters. It is, however, inevitable that a relayer will occasionally find himself short after the proper importing season is over, and the purchase of a small stock of several kinds of cheap oyster in May was considered likely to afford some information of value. Circumstances of temperature were fairly favourable, and the stock travelled well. On the whole, it appears that while these late importations give rise to risks of failure of proper growth and fattening, these risks and that of mortality are not sufficient to deter a relayer who has imperative need to fill up with stock for the coming autumn market. We are aware that small French oysters are very often imported to England in late spring and early summer, and suppose that this practice may be due to unwillingness to immediately expose the stock to the low temperatures of winter and early spring in English waters. No such danger appears to exist in regard to layings on the west coast of this country, and the risk of exposure to high temperature in transit in April or later seems, from our own experience and that afforded by reports of importations to licensed beds, to be much greater.

We do not consider that the number of Falmouths dealt with at Burren is sufficient to give a conclusive result on any of the questions relating to this variety. A further importation has been accordingly made to Ardfry, and though the results are not yet in form for publication, it may be stated that in the lean season of 1904 they did exceptionally well as compared with other varieties under observation.

* Except in the pond at Ardfry, where the green colour is due to the same cause as at Marennes

TABLE

GROUND LAYINGS

"WHITSTABLE NATIVES" OR KENTISH KNOCK.

Reference Number.	Date of Laying.	Quality.	Bed.	Number Laid.	Size.	Average Gross Weight in Grmes.	Date of Raising.	Number Raised (Living).	Losses, including Dead and Missing.	NUMBERS RAISED 5	Average Gross Weight in Grmes.	3½″	Average Gross Weight in Grmes.	3″
1	20. v. 02	Kentish Knock.	Arklow 12A.	85	3″	102·4		77	8	*1	–	10	–	48
							1. xi. 02.	74		1	235·0	8	140·0	48
							2. xii. 02.	3		–	–	2	–	–
2	20. v. 02.	Kentish Knock.	Arklow 12A.	150	2½″	57·0 from sample of 100		149	1	–	–	–	–	16
							19. vii. 02.	50		–	–	–	–	–
							31. x. 02.	89		–	–	–	–	14
							4. xi. 02.	10		–	–	–	–	2
3	20. v. 02.	Kentish Knock.	Arklow 12A.	600	2″	38·0 from sample of 100.		521	79	–	–	–	–	36
							1. xi. 02.	488		–	–	–	–	36
							4. xi. 02.	33		–	–	–	–	–
4	20. v. 02.	Kentish Knock.	Arklow 12B.	1,000	1½″ and under	15·0 from sample of 100.		708	292	–	–	–	–	–
							1. xi. 02.	703		–	–	–	–	–
							4. xi. 02.	5		–	–	–	–	–

TABLE

GROUND LAYINGS

"WHITSTABLE NATIVES" OR KENTISH KNOCK (RELAID)

Reference Number.	Date of Laying.	Quality.	Bed.	Number Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Number Raised (Living).	Losses, including Dead and Missing.	NUMBERS 5″	Average Gross Weight in Grmes.
				920					177 [c]	–	–	–
5	1. xi. 02	Kentish Knock 3″. Relaid. See Ref. No. 1.	Arklow 22	1	5″	235·0	–	25. vii. 03.	(245) [d]	743 [e]		
				10	3½″	140·0	–					
				16	2½″	74·7	–					
	to	Kentish Knock 2″. Relaid. See Ref. No. 3.	"	165	2½″	49·0	5·2					
				220	2″	39·9	4·4					
		Kentish Knock 1½″. Relaid. See Ref. No. 4.	"	18	2½″	36·8	4·0					
				222	2″	27·7	3·1					
	2. xii. 02.			268	1½″	16·2	3·7					
5A	25. vii. 03.	Kentish Knock Relaid. See Ref. No. 5.	Parkmore.	245	Assorted	–	–	6. xi. 03.	177		–	–

(a) 50 of the

(c) Total number raised at

(d) Total number raised in July, not

(e) Total losses for whole period

* The presence of this oyster must be ascribed to faulty sizing when laying, but as it was included

XV.

AT BURREN.

Results of Raising at Stock-taking of 1st Year.

(LIVING), WITH SIZES AND AVERAGE WEIGHTS.

Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2½"	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2"	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	1½"	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	Reference Number.
-	-	-	17	-	-	-	1	-	-	-	-	-	-	-	1
106·3	48	9·6	16	74·7	-	-	1	40·0	-	-	-	-	-	-	
-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	117	-	-	-	14	-	-	-	2	-	-	-	2
-	-	-	50 a	68·2	25	5·6	-	-	-	-	-	-	-	-	
75·9	-	-	59	61·9	50	6·6	14	43·2	-	-	2	-	-	-	
-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	215	-	-	-	270	-	-	-	-	-	-	-	3
80·6	36	6·1	182	49·0	50	5·2	270	39·9	50	4·4	-	-	-	-	
-	-	-	33	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	68	-	-	-	272	-	-	-	368	-	-	-	4
-	.	-	68	36·8	50	4·0	272	27·7	50	3·1	363	16·2	100	3·7	
-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	

XVI.

AT BURREN.

Results of Raising at Stock-taking of 2nd Year.

RAISED (LIVING), WITH SIZES AND AVERAGE WEIGHTS.

3½"	Average Gross Weight in Grmes.	3"	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2½"	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2"	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	1½"	Average Gross Weight in Grmes.	Reference Number.
-	-	7	-	-	-	68	-	-	-	85	-	-	-	17	-	5
-	-	7	67·9	-	-	68	57·4	10	7·5	85	38·2	25	4·0	17	20·9	

largest were taken.
final raising and sizing.
sized; transferred to Parkmore—see Ref. No. 5A.
during which oysters were laid.
in the number from which the initial average gross weight was taken it has been retained.

TABLE

GROUND LAYINGS

FALMOUTH OYSTERS. Results of

Reference Number.	Date of Laying.	Quality.	Bed.	Number Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Number Raised (Living).	Losses including Dead and Missing.	3½″	Average Gross Weight in Grmes.
1	12. vi. 02.	Falmouth (direct).	Arklow, 10c.	56 [c]	3″	75·8	–	3. xi. 02.	44	12	8	104·4
2	12. vi. 02.	Falmouth (direct).	Arklow, 10c.	1,525 [c]	2½″	52·0 from sample of 100.	–		1,185	340	2	–
								19. vii. 02. 3. xi. 02. 4. xi. 02.	50 1,045 90		– 2 –	– (62·3) [d] –
3	12. vi. 02.	Falmouth (direct).	Arklow, 10c.	3,052 [c]	2″	40·0 from sample of 100.	–		2,510	542	8	–
								30–31. x. 02. 3–4. xi. 02.	2,452 58		8 –	68·7 –

TABLE

GROUND LAYINGS

FALMOUTH OYSTERS (RELAID). Results

Reference Number.	Date of Laying.	Quality.	Bed.	Number Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Number Raised (Living).	Losses including Dead and Missing	3½″	Average Gross Weight in Grmes.
4	3. xi. 02.	Falmouth, 2½″. Relaid. See Ref. No. 2.	Arklow, 21.	73 24	3½″ and 3″	62·3	7·0	20. x. 03.	30	43	–	–
	30–31. x. 02.	Falmouth, 2″. Relaid. See Ref. No. 3.		8	3½″	68·7	–					
				41	3″	55·2	6·1					
5	3–4. xi. 03.	Falmouth, 2½″. Relaid. See Ref. No. 2.	Arklow, 21.	1,688 669 55	2½″	53·8 –	5·8 –	20. x. 03.	613	1,075	–	"
	30. x. 03 to 4. xi. 03.	Falmouth, 2″. Relaid. See Ref. No. 3.		906 58	2½″	46·0 –	5·1 –					
6	3–4. xi. 03.	Falmouth, 2½″. Relaid. See Ref. No. 2.	Arklow, 21.	1,537 155 35	2″	47·7 –	4·8 –	20. x. 03.	352	1,185	–	–
	30–31. x. 03.	Falmouth, 2″ Relaid. See Ref. No. 3.		1,343	2″	41·4	4·0					
				4	1½″	30·8	–					

a Includes one 3″ oyster. *b* Fifty of the largest taken. *c* A further number of this sample was examined on 28. 7. 02. Average gross weight 40·9 grmes. Average fish weight 3·8 grmes. *d* Two 3½″ were weighed with the

XVII.

AT BURREN

Raising at Stock-taking of 1st Year.

Numbers Raised (Living), with Sizes and Average Weights.																Reference Number.
Fish Weight.		3″	Average Gross Weight in Grmes.	Fish Weight.		2¼″	Average Gross Weight in Grmes.	Fish Weight.		2″	Average Gross Weight in Grmes.	Fish Weight.		1½″	Average Gross Weight in Grmes.	
No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes			
9[a]	9·8	25	83·0	24	8·1	11	76·8	11	6·4	-	-	-	-	-	-	1
-	-	72	-	-	-	833	-	-	-	278	-	-	-	-	-	2
- - -	- - -	- 72 -	- 62·3[d] -	- 50 -	- 7·0 -	50[b] 728 55	59·8 53·8 -	20 50 -	5·4[c] 5·8 -	- 243 35	- 47·7 -	- 75 -	- 4·8 -	- - -	- - -	
-	-	91	-	-	-	1,014	-	-	-	1,393	-	-	-	4	-	3
- -	- -	91 -	55·2 -	50 -	6·1 -	956 58	46·0 -	50 -	5·1 -	1,393 -	41·4 -	50 -	4·0 -	4 -	30·8 -	

XVIII.

AT BURREN.

of Raising at Stock-taking of 2nd Year.

Numbers Raised (Living), with Sizes and Average Weights.																Reference Number.
Fish Weight		3″	Average Gross Weight in Grmes.	Fish Weight.		2½″	Average Gross Weight in Grmes.	Fish Weight.		2″	Average Gross Weight in Grmes.	Fish Weight.		1½″	Average Gross Weight in Grmes.	
No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes.			No Examined.	Average Weight in Grmes.			No Examined.	Average Weight in Grmes.			
-	-	18	77·8	-	-	12	64·6	-	-	-	-	-	-	-	-	4
-	-	16	73·4	-	-	413	58·4	50	7·0	184	49·3	50	5·9	-	-	5
-	-	-	-	-	-	33	53·8	10	7·5	311	44·9	49	5·2	8	32·5	6

72 3″. c 60 3″, 1,770 2¼″, and 3,285 2″ were received 3rd May, 1902, and laid temporarily, raised on various dates to June 12, 1902, and relaid on Arklow 10 c. Losses to date of laying—4 3″, 245 2¼″, and 233 2″.

TAB[LE]

GROUND LAYING[S]

ISLE OF WIGHT NATIVES. Results [of]

Reference Number.	Date of Laying.	Quality.	Bed.	Number Laid.	Size.	Average Gross Weight in Grmes.	Date of Raising.	Number Raised (Living).	Losses, including Dead and Missing.	NUMBER[S] $3\frac{1}{2}''$.	NUMBER[S] Average Gross Weight in Grmes.
1	18. i. 02.	Isle of Wight, Natives, (direct).	Arklow, 2 a and b.	2,182	3″	65·6 from sample of 32.		1,577	605	-	-
							7. vi. 02.	10		-	-
							9. xii. 02.	1,567		-	-
2	18. i. 02.	Isle of Wight, Natives, (direct).	Arklow, 2 c and d.	2,519	$2\frac{1}{2}''$	49·7 from sample of 89.	9. xii. 02.	1,196	1,323	-	-
3	27. i. 02.	Isle of Wight, Natives, (direct).	Hynes Deep, 1 a.	2,000 1,000 1,000	 $2\frac{1}{2}''$ 2″	49·7 as above. 40·7 from sample of 94.	29. i. 03.	767	1,233	89	*84[illegible]
4	27. i. 02.	Isle of Wight, Natives, (direct).	Illauna-craggah, 1a.	1,264 1,000 264	 $2\frac{1}{2}''$ 2″	as above.	29. i. 03.	586	678	-	-
5	27. i. 02.	Isle of Wight, Natives, (direct).	Red Bank.	1,000	2″	40·7 from sample of 94.		690	310^d	-	-
							20. v. 02.	$(710)^c$		-	-
							12. vi. 02.	$(140)^c$			
5A	to 12. vi. 02.	Isle of Wight, Natives, from Red Bank. See Ref. No. 5.	Arklow, 11.	850	-	-	[illegible] xi. 02.	690^b		-	-

a Spat detached from shells.

b Total number raised (living) at final raising and sizing.

* These weights are correct according to the material at our disposal,

XIX

AT BURREN.

Raising at Stock-taking of 1st Year.

Raised (Living), with Sizes and Average Weights.																
Fish Weight.		3″.	Average Gross Weight in Grmes.	Fish Weight.		2½″.	Average Gross Weight in Grmes.	Fish Weight.		2″.	Average Gross Weight in Grmes.	Fish Weight.		Not Sized.		Reference Number.
No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes.	No. Weighed.	Average Gross Weight in Grmes.	
-	-	391	-	-	-	640	-	-	-	36	-	-	-	10	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	
-	-	391	74·5	50	7·2	640	66·3	50	5·2	35	45·1	36	3·9	40[a]	-	
-	-	426	75·3	50	7·8	650	61·0	50	6·0	120	46·4	50	2·1	1[a]	-	2
50	9·2	309	*47·6	50	9·2	272	*38·5	50	6·8	97	*53·1	50	4·8	-	-	3
-	-	311	75·7	50	8·5	235	57·3	50	6·0	40	45·6	40	4·5	-	-	4
-	-	76	-	-	-	303	-	-	-	311	-	-	-	-	-	5
-	-	-	-	-	-	-	-	-	-	-	-	-	-	(200)[c]	35·5	
-	-	76	59·5	50	6·2	303	51·4	50	5·6	311	40·8	50	3·8	-	-	5A

c Not sized; transferred to Arklow, 11.

d Total losses during whole period of laying.

but it seems probable that there is some error in the record.

GROUND LAYINGS

ISLE OF WIGHT NATIVES (RELAIL)

Reference Number.	Date of Laying.	Quality.	Bed.	Number Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Number Raised. (Living).	Losses, including Dead and Missing.	NUMBERS 3½".	Average Gross Weight in Grmes.
6	9. xii. 02. to 29. i. 03.	Isle of Wight, 2½". (Relaid). See Ref. No. 2.	Hynes Deep, 9 East and West.	3 334 376 600	 3" 2½"	 75·3 61·0	 7·8 6·0	6. xi. 03.	819	2,515	16	107·8
		Isle of Wight, 3". (Relaid). See Ref. No. 1.		841 590	3" 2½"	74·5 66·3	7·2 6·2					
		Isle of Wight, 2½" and 2". (Relaid). See Ref. No. 3.		259 222	3" 2½"	*47·6 *38·5	9·2 6·8					
		Isle of Wight, 2½" and 2". (Relaid). See Ref. No. 4.		261 185	3" 2½"	75·7 57·3	8·6 6·0					
7	9. xii. 02. to 29. i. 03.	Isle of Wight, 2½". (Relaid). See Ref. No. 2.	Arklow, 14 b.	156 70	 2"	 46·4	 2·1		60 [a]		6	-
		Isle of Wight, 2½" and 2". (Relaid). See Ref. No. 3.		47 39	2" 3½"	53·1 *84·8	4·8 9·2	25. vii .03	(83) [b]	96 [c]		
7A	25. vii. 03.	Isle of Wight. (Relaid). From Arklow 14 b. See Ref. No. 7.	Parkmore.	83	-	-	-	6. xi. 03.	60 [a]		6	103·3

a Total number raised (living) at final raising and sizing.
b Not sized; transferred to Parkmore.

XX.

AT BURREN.

Results of Raising at Stocktaking of 2nd Year.

Raised (Living), with Sizes and Average Weights.																
Fish Weight.		3″.	Average Gross Weight in Grmes.	Fish Weight.		2½″.	Average Gross Weight in Grmes.	Fish Weight		2″.	Average Gross Weight in Grmes.	Fish Weight.		Not Sized.		Reference Number.
No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes			No. Examined.	Average Weight in Grmes.			No. Examined.	Average Weight in Grmes	No. Weighed	Average Gross Weight in Grmes.	
-	-	382	87·1	50	8·9	399	71·7	50	7·2	22	55·0	-	-	-	-	6
-	-	18	-	-	-	15	-	-	-	21	-	-	-	-	-	7
-	-	18	91·7	-	-	15	63·3	-	-	21	51·2	-	-	-	-	7A

c Total losses during whole period of laying.

* See note * on Table XIX.

TABLE

GROUND LAYINGS

DUTCH OYSTERS. Results of Raising

Reference Number.	Date of Laying.	Quality.	Bed.	Number Laid.	Size.	Average Gross Weight in Grmes.	Date of Raising.	Number Raised (Living).	Losses including Dead and Missing.
1	12. vi. 02.	Dutch. (direct).	Arklow, 10 d.	607 [a]	2½″	43·1	 20. vii. 02. 31. x. 02. 16. xi. 02.	494 60 414 30	113
2	12. vi. 02.	Dutch. (direct).	Arklow, 10 e.	302 [a]	2″	35·8	 31. x. 02. 14. xi. 02.	212 203 9	90

TABLE

GROUND LAYINGS

DUTCH OYSTERS (RELAID). Results of

Reference Number.	Date of Laying.	Quality.	Bed.	Number Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Number Raised (Living).	Losses including Dead and Missing.
3	31. x. 02. to 16. xi. 02.	Dutch 2½″. Relaid. See Ref. No. 1.	Arklow, 21.	82 4 73	 3″ 2½″	 – 53·2	 – 7·3	20. x. 03.	51	31
	31. x. 02.	Dutch 2″. Relaid. See Ref. No. 2.		5	2½″	46·0	–			
4	31. x. 02.	Dutch 2½″. Relaid. See Ref. No. 1.	Arklow, 21, N.E.	424 267	2″	47·1	5·8	20. x. 03.	81	343
		Dutch 2″. Relaid. See Ref. No. 2.		157	2″	40·9	4·8			

[a] 1,010 living and 10 dead were received April 26, 1902, sized into 660 2½″ and 350 2″, laid temporarily,

XXI.

AT BURREN.

at Stock-taking of 1st Year.

Numbers Raised (Living), with Sizes and Average Weights.												
3″	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes	2½″	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2″	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	Reference Number.
4	-	-	-	173	-	-	-	317	-	-	-	1
-	-	-	-	50	50·5	25	5·1	-	-	-	-	
1	55·0	-	-	96	53·2	50	7·3	317	47·1	50	5·8	
3	-	-	-	27	-	-	-	-	-	-	-	
-	-	-	-	5	-	-	-	207	-	-	-	2
-	-	-	-	5	46·0	-	-	198	40·9	50	4·8	
-	-	-	-	-	-	-	-	9	-	-	-	

XXII.

AT BURREN.

Raising at Stock-taking of 2nd Year.

Numbers Raised (Living), with Sizes and Average Weights.												
3″	Average Gross Weight in Grmes	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2½″	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2″	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	Reference Number.
6	77·5	-	-	39	60·3	10	8·5	6	50·0	-	-	3
-	-	-	-	15	55·0	-	-	66	47·3	10	7·0	4

and raised and relaid on various dates to June 12th. Losses up to June 12, 53 2½″ and 48 2″.

iv.—Ballynakill Experiments.

Tables XXIII. to XXVI.

The experiment was commenced in April, 1902, with ground layings of 2,500 Tralee oysters, and of some small samples of Clarenbridge and Arcachons sent from Burren.

Tralees, 1902.—The oysters were raised for examination in September and October of the same year, and were weighed (gross) and resized into half-inch sizes. The oysters were, on the whole, found to have increased in gross weights, the proportionate increase being more marked in the smallest size laid (2″) than in the the 3″ and $2\frac{1}{2}$″. As no samples of "fish" were taken at this date, it is not possible to say whether there was a corresponding improvement in condition. It is probable, however, that, as compared with similar layings at Burren, the general condition of the Ballynakill oysters was hardly as good. The growth of the larger size laid at Ballynakill ($2\frac{1}{2}$″) is inferior to that found at Burren; the growth of the 2″ oysters is about the same in both places, possibly slightly in favour of the Ballynakill oysters.

As the oysters were not laid for the same period the losses are hardly comparable, the figures being:—

Ballynakill—Total losses, 103 per thousand laid.
Burren — Total losses, 469 ,, ,, ,,

It must, however, be remembered that, apart from the difference in the period of laying, the oysters at Ballynakill may be said to have received more individual attention than did those at Burren.

The local conditions varied much. At the former place the beds were practically dry at very low strands, and it was possible, as the numbers of oysters dealt with were small, to devote special attention to collecting stragglers. Moreover, there was no danger of sanding, the soil being gravelly at the sites of the layings, and the tides very gentle.

Clarenbridges, 1902.—The numbers of Clarenbridge oysters land at Ballynakill during 1902 were small (see Table XXIII.), there being only 90 oysters of each half-inch size available for laying.

A comparison with the Burren oysters, from which these samples were taken (see Table V.), shows that the increase in gross weight was considerably greater at Burren. No samples were examined for "fish" at Ballynakill, but it is most probable that, considering the relative growth and gross weights of the oysters when raised, there would have been found a corresponding inferiority in the weight of the "fish."

The losses at Ballynakill were very small compared with those at Burren—

Total losses—Ballynakill, 85 per thousand laid.
,, Burren, 438 ,, ,,

However, the same remarks (see above) apply as in the case of the Tralees.

Arcachons, 1902.—A similar small number of Arcachons were laid (see Table XXIII.), and the results of their raising show that the progress at Ballynakill was not so good as at Burren; the relative gross and fish weights being considerably less at Ballynakill.

The relative growth at Ballynakill was considerably better than at Burren, but the numbers are too small to be of much importance; it may be noted that the wild oysters at Ballynakill show great growth of shell, but only specimens of 3″ or $3\frac{1}{2}$″ commonly "fish" well.

The losses were small at Ballynakill—

Total losses—Ballynakill, 103 per thousand laid.

" Burren, 309-510 " "

It must be remembered that, besides the differences in the natural conditions of the two places, the oysters sent to Ballynakill had become more or less acclimatised at Burren, and that, therefore, their losses when relaid at the former place might reasonably be expected to be less; but the elimination at Ballynakill of the risk of "sanding" is probably of great importance.

Tralees and Clarenbridges, 1903.—In 1903, a small number of Irish oysters (Tralees and Clarenbridges) were tried in caisses; an examination of Table XXIV. will show that the results obtained were not satisfactory. There was little growth, and only a small increase in gross and fish weights, and the oysters were not in good condition when examined. It will be noted that considerably better results were obtained from samples examined earlier in the year.

The losses at Ballynakill were on the whole somewhat less than at Burren, viz. :—

—	Per Thousand Laid.
Tralees—Caisses, Ballynakill, ...	153
Ground by Caisses, Ballynakill, ..	210
Caisses, Burren, ...	209
Ground by Caisses, Burren, ...	400
Clarenbridges—Caisses, Ballynakill, ...	178
Caisses, Burren, ...	129
Ground by Caisses, Burren, ...	253

Arcachons, 1903.—It is unnecessary to recapitulate the particulars as to prices, route, &c., as these have already been given in connection with the Burren consignment (see p. 230).

The oysters were imported from France direct to Ballynakill, arriving on April 7, and were then divided into different half-inch sizes, and laid in caisses on various dates between April 13th and 28th (see Table XXVI.).

The consignment arrived in good condition, there being only eight dead oysters removed within the first week after arrival. A considerable number of the oysters were showing new growth when they arrived.

In February, 1904, the contents of the several caisses were consigned to Ardfry, where they were resized and weighed in March and April (see Table XXVI.).

Considering the season of year, it is not likely that either size or weight of individuals was affected, unless unfavourably, by any delay that took place in stocktaking after the transfer. Probably the journey did the oysters some harm; and between their arrival and the earliest date on which it was possible to take account of them they were exposed, for the most in somewhat overcrowded caisses, to conditions not the most favourable.

It will be noted on an examination of Table XXVI. that there are several very serious discrepancies between the numbers raised and laid after deduction of losses.

Taking the largest size ($2\frac{1}{2}''$) laid of the first quality into consideration, it appears that 351 oysters are unaccounted for; it is practically certain

that this loss occurred in the caisse of $2\frac{1}{2}''$ oysters, which was situated to the east of Ross Boulder,* where it was exposed to the full force of south-easterly gales; similar losses were experienced in other caisses laid in this exposed position.

It is not possible that any of these oysters should have been subsequently transferred into the caisses with 2″ oysters, as these latter were staked at Rossdhu Stream, quite 400 yards distant (see map).

The missing, therefore, while they go to swell the losses, do not affect the results of the survivors.

With regard to the "excess" of 185 oysters which appears among the 2″ of the first quality, it seems most improbable that it could have arisen at Ballynakill by any other cause than that of a mistake in count.

All the caisses of 2″ were laid at Rossdhu Stream, a situation where they were well sheltered from any wind or sea; an error of one "hand" (5 oysters) in every 1,000 laid would more than account for the excess. It may, however, be due to a mistake at Ardfry.

In either case, whether the excess is to be attributed to a mistake in counting, or to an admixture of oysters of a similar nature, which, if it took place, must have happened at Ardfry, the number is not sufficient to affect materially the results.

As regards the second quality, the only size of which any considerable number was available for final examination is the 2″.

There is here an excess of 455 oysters over the number originally laid; this is too large a number to be attributed to a mistake in counting, and renders the value of the results of the examination somewhat problematical.

The caisses in which the oysters were laid were staked at Ross Stream, and were exposed to considerable sea and wind; but as there were no other oysters of a similar quality laid in their vicinity it seems improbable that the excess could have arisen from a transfer of oysters found on the ground near the caisses.

On the whole, it would appear advisable to disregard the results of their examination, so far as weights and sizes are concerned.

Adverting once more to the first quality Arcachons at Ballynakill, it does not seem practicable to compare their development with that of similar quality at Burren; not, at any rate, when taking the quality as a whole and comparing the net results; but as the first qualities of both consignments appear to have contained a large proportion of 2″ oysters, the gross weights of which approximate very closely, it seems useful to compare the relative growth, &c., attained by this size at Burren and at Ballynakill.

The numbers raised and available for comparison will be seen from Tables XIV. and XXVI., and when summarised are:—

—	Gross No. Laid.	Gross No. Raised.	Nos. at Sizes. 3″.	2½″.	2″.	1½″.
Burren, ...	3,595	2,824	79	939	1,745	61
Ballynakill, ...	4,356	2,776	75	1,023	1,676	2

Total losses, Burren (April to September) 820, or 228 per 1,000 laid.

Total losses, Ballynakill (April, 1903—April, 1904), 1,765, or 405 per 1,000 laid, viz.:—

Dead shells removed at inspections at Ballynakill, April, 1903—February, 1904 . 1,422, or 326 per 1,000 laid.

Dead shells removed at inspections at Ardfry, February, 1904—April, 1904 . . 343, or 79 ,,

* About half-way along the north shore of Fahy Bay (see map following p. 98).

If the numbers at sizes shown above are in both cases reduced for comparison to a standard of 1,000 oysters raised, the relative growth is:—

—	3″.	2½″.	2″.	1½″.
Burren, per thousand raised, ...	28	333	618	22
Ballynakill, per thousand raised, ...	27	369	604	1

This would show a slight superiority in growth in the Ballynakill oysters, which is accompanied by a corresponding increase in the average gross weights (see Tables XIV. and XXVI.). It is, however, quite possible that this superiority is due to the death, after removal to Ardfry, of the stunted or sickly oysters.

The 2½″ (laid) oysters of the first quality (see Ref. No. 1, Table XXVI.) did not do well; their average gross weights are uniformly lower than those of similar raised sizes of the oysters laid as 2″; their comparative growth is also less.

At this stage of the experiment it does not appear possible to assign this want of progress to any definite cause; it may, however, be mentioned that a similar want of development was noted in the same oysters at Burren (see p. 254).

Aurays, 1903.—These oysters are similar to those obtained for Burren (see Table XI., and pp. 231 and 255-6), and with the exception of the second consignment of third grade oysters, arrived at the two places at practically the same time. After resizing into half-inch sizes, they were laid in caisses on the dates mentioned (see Table XXV.).

The same quantities of each grade were ordered for both places with a view to determining their development under different natural conditions; owing, however, to an error in their treatment on arrival, all the third grade (2½—4 cm.) oysters died.* A further number was ordered to replace these, but were not supplied until late in June, and are, therefore, not comparable with the third grade of the Burren consignment.

The condition of the oysters of the first (5—6 cm.) and second (4—5 cm.) grades on arrival at Ballynakill appears to have been much the same as that of the Burren consignment, the second grade oysters being a rather sickly lot, and containing a larger proportion of dead oysters than the first grade, viz., 147 as compared with 24; the number of dead removed at the first inspection was also considerable.

The second consignment of third grade oysters travelled badly, 893 dying within a fortnight of arrival; and it is doubtful whether they ever recovered from the effects of the journey.

There are some discrepancies (noted on Table XXV.) between the numbers of Aurays raised and laid. They are not, however, serious, the "excesses" being not more than may be reasonably expected to take place in counting large quantities of these very small oysters. The "missing" are undoubtedly to be ascribed to the situation of the caisses, some of which were in exposed positions on Knocknahaw shore, while in one instance, viz., the oysters of "under 1″" of the third grade (see Table XXV., Reference No. 8), some of the missing are known to have slipped through the mesh of the wire.

* In the unavoidable absence of anyone having experience in the treatment of oysters, they were kept, pending measurement, for several days, many layers deep in a tank of sea water, exposed to the sun and not too frequently renewed. Even when the water can be renewed every few hours it is not advisable to keep oysters in this manner for more than a day.

** A comparison is thus possible at any rate between the first and second grade of the Aurays laid in caisses at Burren and Ballynakill.

The total net results in growth obtained at Ballynakill and Burren are, when reduced to a standard of 1,000 raised, in each case :—

—	3″.	2½″.	2″.	1½″.	1″.
Burren, 1st Grade, ...	10	109	450	427	3
Ballynakill, 1st Grade, ...	3	103	408	485	-
Burren, 2nd Grade, ...	-	8	161	639	191
Ballynakill, 2nd Grade, ...	-	39	319	641	-
Burren, 3rd Grade, ...	-	4	227	592	177
Ballynakill, 3rd Grade, ...	-	2	58	473	467

Losses.

Burren, 1st Grade, April—October	-	98 per 1,000 laid
,, 2nd ,, ,,	-	126 ,,
,, 3rd ,, ,,	-	72 ,,

Ballynakill 1st Grade—Total losses, April, 1903—April, 1904, 1,396, or 213 per 1,000 laid, viz :—

Dead shells removed at inspections at Ballynakill, April, 1903, to February, 1904 -	619, or 94 per 1,000 laid
Dead shells removed at inspections at Ardfry, February, 1904, to April, 1904, - - -	264, or 40 ,,
Number of oysters missing at final count, -	513, or 78 ,,

Ballynakill, 2nd Grade—Total losses, April, 1903, to April, 1904, 1,861, or 213 per 1,000 laid, viz. :—

Dead shells removed at inspections at Ballynakill, April, 1903, to February, 1904, -	1,386, or 158 per 1,000 laid
Dead shells removed at inspections at Ardfry, February, 1904, to April, 1904, - -	474, or 54 ,,
Number missing at final count, - -	1.

Ballynakill, 3rd Grade—Total losses, June, 1903, to April, 1904, 3,217, or 352 per 1,000 laid, viz. :—

Dead shells removed at inspections at Ballynakill, June, 1903—February, 1904, -	2,532, or 277 per 1,000 laid
Dead shells removed at inspections at Ardfry, February, 1904—April, 1904, - -	405, or 44 ,,
Number of oysters missing at final connt, -	280, or 31 ,,

The oysters transferred to Ardfry from Burren and Ballynakill are being kept under observation, and their subsequent history will form the subject of a further communication.

* For a comparison of the relative growth of the various laid sizes, see Table XIc, where the growth at Ballynakill is compared with that at Burren as found in caisses and in ground layings (see Tables XIa, XIb.)

TABLES XXIII. TO XXVI.

TABLE

GROUND LAYINGS

TRALEE, CLARINBRIDGE, AND ARCACHON OYSTERS.

Reference Number.	Date of Laying.	Quality.	Position of Bed.	Number Laid.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Number Raised (Living).	Losses, including Dead and Missing.	NUMBERS 3½"	Average Gross Weight in Grmes.
1	—. iv. 02.	Tralee (direct).	Knocknahaw Shore.	131	3"	85·3	8·5 from sample of 5.	3. x. 02.	119*	12	11	117·5
2	—. iv. 02.	Tralee (direct).	Knocknahaw Shore.	623	2½"	59·2 from sample of 100.	5·0 from sample of 5.	 5. vii. 02. 17. x. 02.	582 50[a] 592[b]	41	7 2 5	- 77·0 78·6
3	—. iv. 02.	Tralee (direct).	Ross Shore.	500	2½"	"	"	17 x. 02.	480[c]	20	7	82·7
4	—. iv. 02.	Tralee (direct).	Knocknahaw Shore.	702	2"	38·4 from sample of 100.	5·0 from sample of 5.	1–17. x. 02.	639[d]	63	-	-
5	—. iv. 02	Tralee (direct).	Ross Shore.	500	2"	"	"	1–17. x. 02.	383[e]	117	2	55·5
6	8. iv. 02.	Clarinbridge.[r] Relaid at Burren.	Ross Shore.	90	3"	80·1	7·7 from sample of 10.	20. ix. 02. to 3. x. 02.	83[i]	7	9	94·2
7	8. iv. 02.	Clarinbridge.[s] Relaid at Burren.	Ross Shore.	90	2½"	52 1	5·2 from sample of 10	19. ix. 02. to 3. x. 02.	80[k]	10	2	81·5
8	8. iv. 02.	Clarinbridge.[t] Relaid at Burren.	Ross Shore.	90	2"	39 9	4·2 from sample of 10.	3. x. 02.	84[l]	6	-	-
9	8. iv. 02.	Arcachon.[u] 1st quality. Relaid at Burren.	Knocknahaw Shore.	90	2½"	35·3	3·4 from sample of 10.	 28. ix. 02. 18. x. 02.	82 29[m] 53[n]	8	2 2 -	- 59·0 -
10	8. iv. 02.	Arcachon.[v] 1st quality. Relaid at Burren.	Knocknahaw Shore.	90	2"	31·3	3·1 from sample of 10.	18. x. 02.	68[o]	22	-	-
11	8. iv. 02.	Arcachon.[w] 2nd quality. Relaid at Burren.	Knocknahaw Shore.	90	2½"	29·8	3·5 from sample of 10.	18. x. 02.	88[p]	2	-	-
12	8. iv. 02.	Arcachon.[x] 2nd quality. Relaid at Burren.	Knocknahaw Shore.	90	2"	24·4	2·7 from sample of 10.	3. x. 02.	85[q]	5	-	-

* Average gross weight, 90·3 grmes.
a Average fish weight 5·6 "
 and average gross weight, 63·7 "
b Average gross weight, 63·3 "
c " " " 62·9 "
d " " " 49·0 "

e Average gross weight, 50·4 grmes.
h Includes one 3"
i Average gross weight, 84·9 "
k " " " 58·3 "
l " " " 45·6 "

m Average gross weight, 42·9 grmes.
n " " " 44·0 "
o " " " 38·5 "
p " " " 39·8 "
q " " " 31·0 "

XXIII.

AT BALLYNAKILL.

Results of Raising at Stocktaking, 1902.

RAISED (LIVING), WITH SIZES AND AVERAGE WEIGHTS.

Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes	3″	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2½″	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes.	2″	Average Gross Weight in Grmes.	Fish Weight. No. Examined.	Fish Weight. Average Weight in Grmes	1½″	Average Gross Weight in Grmes.	Reference Number.
-	-	100	89·0	-	-	8	68·1		-	-	-	-	-	-	-	1
-	-	143	-	-	-	401	-	-	-	31	-	-	-	-	-	2
-	-	11	61·3	-	-	37	63·7	-	-	-	-	-	-	-	-	
-	-	132	75·8	-	-	364	62·7	-	-	31	46·4	-	-	-	-	
-	-	119	72·8	-	-	326	60·1	-	-	28	47·8	-	-	-	-	3
-	-	17	62·9	-	-	323	53·2	-	-	297	43·7	-	-	2	26·5	4
-	-	34	59·3	-	-	218	52·9	-	-	129	43·9	-	-	-	-	5
-	-	36	86·8	-	-	38	80·9	-	-	-	-	-	-	-	-	6
-	-	17	60·6	-	-	53	58·0	-	-	8	49·7	-	-	-	-	7
-	-	6	50·3	-	-	41	49·1	-	-	37	41·1	-	-	-	-	8
-	-	8	-	-	-	29	-	-	-	43	-	-	-	-	-	9
2	5·5	1	49·0	1	4·0	6	44·8	6	4·9	20	40·5	20	4·0	-	-	
-	-	7	55·9	-	-	23	46·1	-	-	23	38·4	-	-	-	-	
-	-	2	56·5	2	6·7	28	42·9	23	4·6	35	35·2	-	-	3	25·0	10
-	-	6	54·7	4	6·4	30	43·7	12	5·8	49	36·6	9	4·3	3	24·0	11
-	-	1	41·0	-	-	22	35·8	23[h]	3·6	50	30·7	2	4·4	12	22·6	12

r For previous history see Table V. Ref. No. 2.
s " " " " V. " 4.
t " " " " V. " 6.
u " " " " XII. " 1.

v For previous history see Table XII. Ref. No. 2.
w " " " " XII. " 3.
x " " " " XII. " 4.

TABLE

CAISSE EXPERIMENTS

TRALEE AND CLARINBRIDGE OYSTERS.

Reference Number.	Date of Laying.	Quality.	Caisse or Ground Laying.	Position.	Total Number of Oysters in Caisse or Laying, and Number in each Division of Caisse.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Date of Raising.	Number Raised (Living).	LOSSES. Dead Shells removed at Inspections.	LOSSES. Number Missing at Final Count
1	28. i. 03.	Tralee (direct).	Caisse G. (part of).[a]	Ross Stream.	729 G i. 99 G ii. 238 G iii. 392	2″	37·3	4·4 from sample of 50	 29. vi. 03. 4. xi. 03.	659 25 [b] 634 [d]	66	4 [e]
2	28. i. 03.	Tralee (direct).	Caisse H.	Rossdhu Stream.	900 H i. 200 H ii. 300 H iii. 400	2″	37·3	4·4 from sample of 50.	 29. vi. 03. 5. xi. 03.	810 [g] 25 [b] 785 [d]	93	*Excess* 3
3	28. i. 03.	Tralee (direct).	Ground	Rossdhu Stream.	200	2″	37·3	4·4 from sample of 50.	5. xi. 03.	158	42 including dead and missing.	
4	28. i. 03.	Tralee (direct).	Caisse G. (part of).[f]	Ross Stream.	214 GA i. 38 GA ii. 71 GA iii. 105	1½″	28·7	3·6 from sample of 50.	4. xi. 03.	95 [d]	16	103 [e]
5	23. i. 03.	Clarinbridge (direct).	Caisse A.	Ross Stream.	817 A i. 127 " 215 A ii. 300 A iii. 1 " 102 " 72	 2½″ " 3″ 2″ 3″	 48·2* 61·7 61·7 46·1 43·8 92·4	–	4. xi. 03.	682 [h]	40	95
6	28. i. 03.	Clarinbridge (direct).	Caisse E.	Ross Stream.	900 E i. 200 E ii. 300 E iii. 400	2″	40·0	4·8 from sample of 50.	 23. viii. 03. 4. xi. 03.	820 10 [b] 810 [d]	61	19
7	30. i. 03.	Clarinbridge (direct).	Caisse K.	Ross Shore.	915 K i. 215 K ii. 300 K iii. 400	2″	42·4	-	 28. vi. 03. 23. viii. 03. 9. ix. 03. 9. ix. 03. 16. xi. 03. 16. xi. 03.	661 25 [i] 10 [b] 20 [b] 30 [j] 389 [d] 187 [j]	34	220
8	13. iii. 03.	Clarinbridge Dwarfs, relaid at Burren.	Caisse Cx	Rossdhu Stream.	100 Cx. ii. 38 Cx. i. 62	 2½″ 2″	60·7 [l]	6·2 [m]	 22. viii. 03. 5 xi. 03. 5. xi. 03	90 [k] Cx. i. {10, 25} Cx. ii. 55	11	*Excess* 1

* Average fish weight, 6·6 grmes., from sample of 50.

(a) The compartments in Caisse G were divided by a wooden partition; about two-thirds of each were filled with 2″ oysters, and the remaining third with 1½″ oysters. See Ref. Nos. 1 and 4 above.

(b) Sample taken from Division iii.

(c) Average gross weight of 25 (2 2½″ and 23 2″) = 42·8 grmes.

(d) Raised from all the divisions of the caisse.

(e) A number of oysters (98) was found on the ground near Caisse G, and probably included some of those missing. See under "Missing," Ref. Nos. 1 and 4. The numbers at sizes were—13 2½″, average gross weight 45·4 grmes.; 71 2″, average gross weight 37·1 grmes.; 14 1½″, average gross weight 31·2 grmes.

XXIV.

AT BALLYNAKILL.

Results of Raising at Stock-taking, 1903.

Numbers Raised (Living), with Sizes and Average Weights																
						Fish Weight.				Fish Weight.				Fish Weight.		
3½"	Average Gross Weight in Grmes	3"	Average Gross Weight in Grmes.	2½"	Average Gross Weight in Grmes.	No. Examined.	Average Weight in Grmes	2"	Average Gross Weight in Grmes.	No. Examined.	Average Weight in Grmes	1½"	Average Gross Weight in Grmes.	No. Examined.	Average Weight in Grmes.	Reference Number.
-	–	–	–	70	–	–	–	542	–	–	–	47	–	–	–	1
-	–	–	–	2	–	–	–	23	–	25[c]	5·0	–	–	–	–	
-	–	–	–	68	44·0	24	4·5	519	38·0	50	3·2	47	32·0	25	2·9	
-	–	2	–	89	–	–	–	684	–	–	–	35	–	–	–	2
-	–	–	–	–	–	–	–	25	42·9	25	5·5	–	–	–	–	
-	–	2	54·0	89	46·7	25	4·9	659	39·0	50	3·9	35	32·2	–	–	
-	–	–	–	12	42·8	–	–	140	38·6	50	3·7	6	31·8	–	–	3
-	–	–	–	3	39·6	–	–	42	34·1	–	–	50	29·0	–	–	4
10	92·3	124†	84·6	459	63·8	50	5·8	89	50·4	25	4·4	–	–	–	–	5
-	–	–	–	126	–	–	–	656	–	–	–	38	–	–	–	6
-	–	–	–	–	–	–	–	10	47·5	–	–	–	–	–	–	
-	–	–	–	126	48·0	25	4·9	646	41·2	50	3·6	38	37·1	–	–	
-	–	3	–	111	–	–	–	527	–	–	–	20	–	–	–	7
-	–	–	–	–	–	–	–	25	45·6	25	5·6	–	–	–	–	
-	–	–	–	–	–	–	–	10	46·3	–	–	–	–	–	–	
-	–	–	–	–	–	–	–	20	–	–	–	–	–	–	–	
-	–	–	–	–	–	–	–	30	–	–	–	–	–	–	–	
-	–	1	44·0	70	48·5	26	4·8	310	43·0	50	3·9	8	25·0	–	–	
-	–	2	66·0	41	48·5	–	–	132	43·0	–	–	12	27·3	–	–	
-	–	2	–	40	–	–	–	45	–	–	–	3	–	–	–	8
-	–	–	–	10	73·5	–	–	–	–	–	–	–	–	–	–	
-	–	1	92·0	17	77·3	–	–	7	63·3	–	–	–	–	–	–	
-	–	1	78·0	13	74·9	–	–	38	62·3	–	–	3	49·3	–	–	

† Average fish weight, 8·3 grmes., from sample of 24.
(f) See note (a) above.
(g) Includes an excess of 3
(h) Raised from all the divisions of the caisse.
(i) Sample taken from Division i.
(j) These oysters were found on the gronnd beside Caisse K.
(k) Includes an excess of 1.
(l) Average gross weight taken from 149 (60 2½" and 89 2").
(m) Average fish weight taken from 50 (23 2½" and 27 2").

TABLE

CAISSE EXPERIMENTS

AURAY OYSTERS. Laid in Caisses at Ballynakill, April and June, 1903; transferred

Reference Number.	Date of Laying.	Quality.	Number	Size	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Number of Dead Shells removed at inspections at Ballynakill.	Date of Transfer to Ardfry.	Date of Count and Sizing at Ardfry.	Total No. (Living).	Number of Dead Shells removed at Ardfry.	Total Losses, including both Dead and Missing at Ballynakill and Ardfry.
1	10. iv. 03.	Auray 5-6 cm. (direct).	1,007	2″	22·1	-	58	6. ii. 04.	18. iii. 04.	682	23	325 81 Dead 244 Missing.
2	10-28. iv. 03.	Auray 5-6 cm. (direct).	5,555	1½″	16·8	-	561	do.	16. iii. 04 to 2. iv. 04.	4,484	241	1,071 802 Dead. 269 Missing
3	9. iv. 03.	Auray 4-5 cm. (direct).	123	2″	19·5	-	25	6. ii. 04.	1. iv. 04.	90	7	33 32 Dead. 1 Missing.
4	10-28. iv. 03.	Auray 4-5 cm. (direct).	7,103	1½″	13·5	1·5	979	do.	18. iii. 04 to 12. iv. 04.	5,866[a]	377	1,356 Dead.
5	11. iv. 03.	Auray 4-5 cm. (direct).	1,530	1″	9·7	-	382	do.	18. iii. 04 and 1. iv. 04.	1,064[b]	90	472 Dead
6	25. vi. 03.	Auray 3-4 cm. (direct).	655	1½″	7·3	0·9	224	6. ii. 04.	12. iv. 04.	392[c]	50	274 Dead.
7	25-26. vi. 03.	Auray 3-4 cm. (direct).	7,911	1″	4·2	0·5	2,180	do.	13. ii. 04 and 12. iv. 04.	5,417[d]	342	2,522 Dead.
8	25. vi. 03.	Auray 3-4 cm. (direct).	567	Under 1″	2·3	-	128	do.	12. iv. 04.	146	13	421 141 Dead. 280 Missing.

a Includes an excess of 119. *b* Includes an excess of 6.

XXV.

AT BALLYNAKILL.

to Caisses at Ardfry, February, 1904. Results of Raising in March–April, 1904.

Numbers raised (Living), with Sizes and Average Weights.															Reference Number.
3″	No. Weighed.	Average Gross Weight in Grmes.	2½″	No. Weighed.	Average Gross Weight in Grmes.	2″	No. Weighed.	Average Gross Weight in Grmes.	1½″	No. Weighed.	Average Gross Weight in Grmes.	1″	No. Weighed.	Average Gross Weight in Grmes.	
14	14	64·3	288	288	43·2	380	380	32·8	-	-	-	-	-	-	1
2	2	42·5	246	97	37·9	1,728	1,070	26·7	2,508	2,219	18·9	-	-	-	2
-	-	-	29	29	42·2	53	53	30·7	8	-	-	-	-	-	3
1	-	-	246	230	36·8	2,071	2,066	25·7	3,548	3,540	15·9	-	-	-	4
-	-	-	-	-	-	117	117	21·2	947	942	13·6	-	-	-	5
-	-	-	9	-	-	150	150	17·3	233	233	12·1	-	-	-	6
-	-	-	-	-	-	191	137	15·9	2,510	1,999	9·8	2,716	2,154	5·6	7
-	-	-	-	-	-	4	-	-	76	-	-	66	-	-	8

c Includes an excess of 11. *d* Includes an excess of 28.

TABLE

CAISSE EXPERIMENTS

ARCACHON OYSTERS. Laid in Caisses at Ballynakill in April, 1903; transferred

Reference Number.	Date of Laying.	Quality.	Number.	Size.	Average Gross Weight in Grmes.	Average Fish Weight in Grmes.	Number of Dead Shells removed at Inspections at Ballynakill.	Date of Transfer to Ardfry.	Date of Count and Sizing at Ardfry.	Total Number (Living).	Number of Dead Shells removed at Ardfry.
1	13-14. iv. 03.	Arcachon, 1st quality (direct).	938	2¼″	42·3	6·0	277	6. ii. 04.	16-29 iii. 04.	295	15
2	13-14. iv. 03.	Arcachon, 1st quality (direct).	4,356	2″	36·3	4·6	1,422	,,	18. iii. 04. to 7. iv. 04.	2,776 (a)	343
3	28. iv. 03.	Arcachon, 1st quality (direct).	172	1½″	27·4	-	43	,,	29. iii. 04.	90	5
4	15. iv. 03.	Arcachon, 2nd quality (direct).	3,025	2″	28·5	3·5	1,125	6. ii. 04.	16-29 iii. 04.	2,180 (b)	175
5	25. iv. 03.	Arcachon, 2nd quality (direct).	24 (c)	2¼″	33·8	-	4	,,	-	-	-
6	28. iv. 03.	Arcachon, 2nd quality (direct).	960 (d)	1½″	25·3	-	84	,,	-	-	-

(a) Includes an excess of 185.
(b) Includes an excess of 455.
(c) Not counted, sized, &c., at Ardfry.

XXVI.

AT BALLYNAKILL.

to Caisses at Ardfry, February, 1904. Results of Raising in March–April, 1904.

Total Losses, including both Dead and Missing, at Ballynakill and Ardfry.	Numbers Raised (Living), with Sizes and Average Weights.												Reference Number.
	3″.	No Weighed.	Average Gross Weight in Grmes.	2½″.	No. Weighed.	Average Gross Weight in Grmes.	2″.	No. Weighed.	Average Gross Weight in Grmes.	1½″.	No. Weighed.	Average Gross Weight in Grmes.	
643 292 dead. 351 missing.	57	57	52·7	220	220	50·5	18	18	36·7	-	-	-	1
1,765	75	58	68·1	1,023	1,023	53·0	1,676	1,676	40·2	2	2	27·5	2
82 48 dead. 34 missing.	1	-	-	3	-	-	86	86	35·8	-	-	-	3
1,300	-	-	-	41	41	49·9	1,710	1,710	30·9	429	429	26·2	4
-	-	-	-	-	-	-	-	-	-	-	-	-	5
(836) [e]	-	-	-	-	-	-	-	-	-	-	-	-	6

(d) On 23/10/03 these Oysters were recounted, only 145 being found in the caisses, which were in an exposed position. Prior to transfer to Ardfry a further number of dead shells, viz., 21, was removed. The total losses, including missing, to date of transfer to Ardfry, would therefore be 836. The Oysters were not counted, sized, &c., at Ardfry.

(e) Total losses to date of transfer to Ardfry

V.—Seasonal Incidence of Mortality of French Oysters in Caisses.*

In Tables XXVII. XXVIII. and XXIX., an attempt is made to show the relation of mortality to season of year, in so far as the want of regularity in the examination of caisses permits. The upper part of the tables sets forth the actual number of dead found at each examination, and the rate of mortality per thousand (originally laid) per week. The middle part rehearses the same data in cumulative form, and the lower part deals with totals of dead and living.

When a caisse is fairly full of small oysters the removal of all dead shells is a much more difficult feat than may be supposed, especially when it has to be done under water. When, therefore, as especially in Table XXIX., the last record shows a sudden increase in apparent weekly mortality, it may be safely assumed that this is due to the fact that on the final clearing of the caisse there came to light many dead shells which had been overlooked on previous occasions.

When it happens that the earlier records show a higher mortality than those which succeed them, the inference, supported by observation, is that the oysters arrived in bad condition, and that the early mortality is due to the effects of their journey.

In other respects the deductions which may properly be made from the tables are somewhat obscure. The data extend at most from April of one year to February of the next.† It appears that the oysters which arrived in good condition sustained but little loss at Burren until the late summer,‡ and that at Ballynakill the most serious losses occurred in autumn and winter. There is no certain indication of decrease in weekly mortality after these periods at either place, and perhaps the tables only tell us that oysters of these qualities and sizes do not sustain any considerable loss for some time after arrival, supposing the conditions of the journey to have been favourable.

Bulstrode mentions, and one hears frequently, that the small oysters imported from France to the colder waters of England suffer great losses in winter. Such losses may be due, as generally supposed, to cold, but we have some reason to think that on the western beds of Ireland cold is seldom a formidable cause of mortality. Our first consignment of small Aurays was received at Burren in December, 1901, in unusually cold weather for that place, there being a considerable frost at the time. The oysters were got into water at once, and many of them were laid where they could be easily seen at every low tide. Though no steps were taken to record deaths as they occurred, it was matter of remark that very few open shells were to be seen for some months, whereas in the summer mortality became very noticeable. The caisse records of Aurays do not throw light upon this question, as the consignments came late, because, owing to stormy weather, the first lot collected for us by the exporter was scattered.

Our first consignment of Arcachons was delayed until March on account of severe cold *at Arcachon*, which made the exporter unwilling to expose them to the risks of raising and transport. Apparently it was colder at Arcachon than at Burren.

We shall deal fully with the question of temperature and salinity in a future communication, but we do not think that the preliminary conclusions indicated above will be affected by later experience. Everywhere there may be exceptional frosts, as at Auray some years ago, when a severe frost at spring-tides congealed the top spit of the layings into a solid crust, which the rising tide lifted and carried away.

* The caisses containing Irish oysters were not visited with sufficient regularity to permit of an attempt to assign mortality to particular periods.

† In Hock's experiments the mortality seems, as in the case of our own ground layings, to have become acute in the second year, though the oysters were not disturbed except by the dredging necessary to obtain samples for examination. So far as his methods suffice to demonstrate, the death rate assumed its most serious proportions in the summer of the second year.

‡ But the Ballynakill lot was sized more rapidly than the Burren lot. Consequently by the time the latter were laid in caisses, a good number of those which died from the effects of the journey had been eliminated.

SEASONAL INCIDENCE OF MORTALITY OF ADULT OYSTERS LAID IN CAGES AT BURHAM

Period	Adult Oysters. Trade Size 1-4 centimetres, or 1st Grade. Total Number [illegible]										Adult Oysters. Trade Size 5-8 centimetres, or 2nd Grade. Total Number [illegible]								Adult Oysters. Trade Size 9-12 centimetres, or 3rd Grade. Total Number [illegible]									
	Cages IX. [illegible] Laid week ending April 19, '02		Cages X. [illegible] Laid week ending April 19, '02		Cages XI. [illegible] Laid week ending April 19, '02		Cages IX., X., and XI. combined. Total [illegible]		Cages II. [illegible] Laid week ending April 19, '02		Cages XIII. [illegible] Laid week ending April 19, '02		Cages XIV. [illegible] Laid week ending April 19, '02		Cages XIII. and XIV. combined. Total [illegible]		Cages I. [illegible] Laid week ending April 19, '02		Cages XVII. [illegible] Laid week ending May 3, '02		Cages XVIII. [illegible] Laid week ending May 3, '02		Cages XIX. [illegible] Laid week ending May 3, '02		Cages XVII., XVIII. and XIX. combined. Total [illegible]		Cages XVIa. [illegible] Laid week ending May 3, '02	
Weeks from date of laying of Cages for which are recorded	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.
1 Week during April 19	—	—	—	—	—	—	—	—	[illegible]	[illegible]	—	[illegible]	—	[illegible]	—	—	[illegible]	[illegible]		—	—	—			—	—		
1 " May 3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—					—	—	—	
4 Weeks " 31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 " June 27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 " July 25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 " August 22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 " Sept. 19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1 Week " 26	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2 Weeks October 3	—	—	[illegible]	[illegible]	—	—	[illegible]	[illegible]	[illegible]	[illegible]	—	—	[illegible]	[illegible]	[illegible]	[illegible]	—		—		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—

Total No. of Dead removed during 1 Week (April 13-19)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" 2 (April 20—May 3)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" 20 Weeks (May 4—Sept. 19)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" 20 (May 3—Sept. 19)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" 22 (May 3—Oct. 3)	— —	[illegible]	— —	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Number of Dead Shells removed during whole period during which cases were laid	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Number missing or dead [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Losses	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Number of Oysters during [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible footnotes]

TABLE

SEASONAL INCIDENCE OF MORTALITY OF ARCACHON

PERIOD. Calculated from Date of Laying of Caisses—*i.e.*, Week ending April 25, 1903.	Arcachon Oysters, 1st Quality, Total Number							
	Caisse VI. containing 1,200. 2″.		Caisse VII. containing 1,200. 2″.		Caisse VIII. containing 1,195. 2.″		Caisses VI, VII., and VIII. combined. Total contents 3,595. 2″.	
	Total No. of Dead Shells Removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells Removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells Removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells Removed.	Average Weekly Loss per 1000.
5 weeks ending May 30, ...	8	1·3	6	1·0	4	0·7	18	1·0
4 do., June 27, ...	24	5·0	24	5·0	27	5·7	75	5·2
4 do., July 25, ...	29	8·0	61	12·6	68	14·3	158	11·0
5 do., August 29, ...	39	6·5	95	15·8	127	21·3	261	14·5
2 do., September 12, ...	180	06·7	34	14·0	36	15·1	230	32·0
1 do., do., 19, ...	-	-	17	14·0	18	15·1	(35)	(14·6)
2 do., October 3, ...	-	-	34	14·0	-	-	(34)	(14·0)
Total Number of Dead removed for 20 weeks ending Sept. 12, ...	*260 or 216·7 ‰		218 or 181·7 ‰		263 or 220·2 ‰		741 or 206·1 ‰	
Total Number of Dead removed for 21 weeks ending Sept. 19, ...	-	-	235 or 195·8 ‰		*281 or 235·1 ‰		776 or 215·9 ‰	
Total Number of Dead removed for 23 weeks ending October 3,	-	-	*269 or 224·2 ‰		-	-	810 or 225·3 ‰	
Total Number Missing at Final Inspection.	0		3 or 2·5 ‰		7 or 5·9 ‰		10 or 2·8 ‰	
†Total Losses, ...	260 or 216·7 ‰		272 or 226·7 ‰		288 or 241·0 ‰		820 or 228·1 ‰	
Total Number of Oysters Raised (living).	(*b*) 982 or 818·3 ‰		(*c*) 930 or 775·0 ‰		(*d*) 912 or 763·2 ‰		2,824 or 785·5 ‰	

* The figures under columns headed "Total Number of Dead Shells Removed" are obtained from the actual number of dead removed proportioned over the period given in Column 1. The loss per thousand is calculated on this number, and is correct to one place of decimals. When the proportioned loss over the period contains a fraction, the nearest whole number is entered. Such error as arises is corrected here * under Total Number removed at end of period of laying.
(*a*) Caisse XV. was not inspected from 13. 6. 03, until final inspection 2. 10. 03.
Note—The symbol ‰ represents "per thousand."

XXVIII.

Oysters Laid in Caisses at Burren.[1]

4,370.		Arcachon Oysters, 2nd Quality, Total Number, 5,971.									
Caisse XV. containing 775. 2½″.		Caisse III. containing 1,200. 2″.		Caisse IV. containing 1,200. 2″.		Caisse V. containing 1,943. 2″.		Caisses III., IV., and V. combined. Total contents 4,343. 2″.		Caisse XII. containing 1,628. 1½″.	
Total No. of Dead Shells Removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells Removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells Removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells Removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells Removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells Removed.	Average Weekly Loss per 1,000.
5	1·2	6	1·1	15	2·5	8	0·8	29	1·3	36	4·4
(a) 22	(a) 7·1	30	6·2	47	9·8	78	10·0	155	8·9	48	7·3
37	11·9	86	18·0	60	12·5	151	19·5	297	17·1	109	16·7
46	11·9	124	20·6	122	20·4	266	27·4	512	23·6	212	26·1
18	11·9	39	16·4	38	15·8	83	21·4	160	18·4	65	19·9
9	11·9	20	16·4	–	–	42	21·4	(62)	(19·7)	82	19·9
18	11·9	39	16·4	–	–	–	–	(39)	(16·4)	–	–
128 or 165·2‰		285 or 237·5‰		*282 or 235·0‰		586 or 301·6‰		1,153 or 265·5‰		469 or 288·1‰	
137 or 176·8‰		305 or 254·2‰		–	–	*628 or 323·2‰		1,215 or 279·8‰		*501 or 307·7‰	
*155 or 200·0‰		*344 or 286·7‰		–	–	–	–	1,254 or 288·7‰		–	–
0		15 or 12·5‰		3 or 2·5‰		13 or 6·7‰		31 or 7·1‰		10 or 6·1‰	
155 or 200·0‰		359 or 299·2‰		285 or 237·5‰		641 or 329·9‰		1,285 or 295·8‰		511 or 313·8‰	
(e) 622 or 802·8‰		841 or 700·8‰		(f) 931 or 775·8‰		(g) 1,303 or 670·6‰		3,075 or 708·0‰		(h) 1,119 or 687·3‰	

(b) Includes an excess of 42 in divisions A. B. and C. of Caisse.
(c) Do., do., 2 in divisions A. and B. of Caisse.
(d) Do., do., 5 in division B. of Caisse.
(e) Do., do., 2 in divisions of Caisse.
(f) Do., do., 16 in divisions B. and C. of Caisse.
(g) Do., do., 1 in division A. of Caisse.
(h) Do., do., 2 in division C. of Caisse.

TABLE XXIX.

SEASONAL INCIDENCE OF MORTALITY OF ADULT OYSTERS LAID IN CAGES AT BALLYMACHILL, APRIL, 1903, TRANSFERRED TO CAGES AT ARDPATRICK, FEBRUARY, 1904.

PERIOD. Calculated from date of laying of Oysters for which are reported.	Adult Oysters. Trade Size, fish used cooking, or 3rd grade. Total Number [illegible]	Adult Oysters. Trade Size, fish used for cooking, or 3rd grade. Total Number, [illegible]
1 Week ending April 18.	[illegible]	[illegible]
1 " " " 25.	[illegible]	[illegible]
4 Weeks May 23.	[illegible]	[illegible]
4 " June [illegible]	[illegible]	[illegible]
4 " July [illegible]	[illegible]	[illegible]
4 " August [illegible]	[illegible]	[illegible]
4 " September [illegible]	[illegible]	[illegible]
4 " October [illegible]	[illegible]	[illegible]
4 " November [illegible]	[illegible]	[illegible]
4 " December [illegible]	[illegible]	[illegible]
4 " January [illegible]	[illegible]	[illegible]
4 " [illegible]	[illegible]	[illegible]
1 Week February [illegible]	[illegible]	[illegible]
Total No. of Dead removed during 1 Week (April 11-18).	[illegible]	[illegible]
" Largest Deaths.	[illegible]	[illegible]
" 16 Weeks (May 23rd–Sept. 12th)	[illegible]	[illegible]
" 3 Weeks (Dec. 5th–Feb. 6).	[illegible]	[illegible]
Total Number of Dead Shells removed during period of laying at Ballymachill.	[illegible]	[illegible]
Total Number of Dead Shells removed during period of lay at Ardpatrick.	[illegible]	[illegible]
Number missing or Dead lost.	[illegible]	[illegible]
Total Losses.	[illegible]	[illegible]
Total number of Oysters killed through [illegible]	[illegible]	[illegible]

[illegible]

TABLE XXIX.—*continued*

SEASONAL INCIDENCE OF MORTALITY OF

AURAY OYSTERS LAID IN CAISSES AT BALLYNAKILL, JUNE 1903, TRANSFERRED TO CAISSES AT ARDFRY, FEBRUARY, 1904

PERIOD. Calculated from date of laying of Caisses, for which see of parks.	Auray Oysters. Trade Size, 3-4 centimetres, or 3rd grade. Total Number 8,138.													
	Caisse Q containing 2,465 1" Laid week ending June 27, 1903.		Caisse Fx containing 2,400 1" Laid week ending June 27, 1903.		Caisse 1 containing 2,090 1" Laid week ending June 27, 1903.		Caisse 9 containing 1,086 2" Laid week ending June 27, 1903.		Caisses Q, Fx, 1 and 8 combined. Total contents, 7,811 1".		Caisse 4 containing 665 1½" Laid week ending June 27, 1903.		Caisse 4 Division A (1 all of), containing 567 under 1" Laid week ending June 27, 1903.	
	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.	Total No. of Dead Shells removed.	Average Weekly Loss per 1,000.
4 Weeks ending July 25,	188	19·3	266	21·1	38	10·9	137	31·2	241	10·3	68	23·7	19	8·4
5 " " August 29,	236	19·3	253	21·1	103	19·9	72	13·5	270	16·9	78	23·7	31	8·4
4 " " September 26,	8	9·9	62	6·4	27	3·4	19	4·2	115	3·9	27	10·3	20	8·8
5 " " October 31,	39	3·9	73	2·8	26	3·3	34	9·3	107	4·2	17	5·1	17	9·1
4 " " November 28,	46	9·3	43	4·5	46	6·7	14	7·4	172	5·1	11	4·1	14	9·1
4 " " December 26,	58	9·0	43	4·5	46	9·7	14	3·4	163	5·1	11	4·1	14	9·1
5 " " January 30,	86	9·9	61	9·1	50	5·9	23	4·3	220	5·8	15	4·9	17	5·3
1 Week " February 6,	27	10·5	18	7·1	13	9·5	9	9·0	67	9·4	4	9·1	2	5·3
Total No. of Dead Shells removed during 32 weeks from June 27 to February 6, period during which Oysters were laid at Ballynakill	*634 or 279·0‰		*754 or 314·2‰		*450 or 215·0‰		*316 or 290·7‰		*2,150 or 275·9‰		*224 or 343·0‰		*128 or 225·7‰	
Total No. of Dead Shells removed during period of laying at Ardfry	—†		—†		—†		—†		342 or 43·9‰		50 or 76·9‰		13 or 21·9‰	
Number missing at final count,	—†		—†		—†		—†		—		—		260 or 433·8‰	
Total Losses,	—		—		—		—		2,692 or 345·8‰		274 or 410·0‰		421 or 742·5‰	
Total Number of Oysters Raised (Living)	—		—		—		—		5,117 or 654·7‰		392 or 589·5‰		118 or 257·5‰	

* The figures in column headed "Total No. of Dead Shells removed" are obtained from the actual number of dead removed, proportioned over the period given in column 1; the loss per thousand is calculated on this number and is correct to one place of decimals. Where the proportioned loss over the period contains a fraction the nearest whole number is entered. Such error as arises from this is corrected here (*) under the "Total No. of Dead Shells removed" &c.

† The contents of this caisse was not kept separate after its removal to Ardfry. The losses, &c. are summarised in column 5, where the contents of the four caisses containing 1" oysters are combined. ‡ Includes an excess of 28 oysters. § Includes an excess of 9 oysters.

NOTE.—The symbol ‰ represents "per thousand."

VI.—Summaries of Losses at Burren and Ballynakill.

These tables require no special explanation, since the results form the subject of comment in other sections of the Report. We may repeat, however, that the second years' layings of the first consignments may have been injuriously affected by over-crowding (see p. 235), and that the results of some of the caisse layings at Ballynakill are rendered unreliable by discrepancies that appear between the numbers laid and raised (see p. 291). These are matters of comparatively little importance, and the tables, as a whole, may be commended to the serious attention of those who may contemplate a relaying enterprise. We have already referred to Hoek's experience of increased mortality in the second year of layings (see p. 304).

SUMMARY SHOWING TOTAL LOSSES ON OYSTERS LAID AT BURREN.

Tralee Oysters (1st Consignment) 1st Year.

Reference. Table.	Reference. No.	Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates† of Raising.	Numbers Raised (Living).	Total Losses, including Dead and Missing. Number.	Total Losses, including Dead and Missing. Loss per 1,000 laid.
I.	1	30. 11. 01 to 13. 2. 02.	Tralee, Direct.	3″ and over.	Ground.	11,238	30. 9. 02 to 20. 10. 02.	7,968	3,270	291·0
I.	2, 3	30. 11. 01 to 14. 2. 02.	Do.	2½″	do.	50,013	9. 10. 02 to 28. 11. 02.	31,784	18,229	364·5
I.	4	10. 12. 01. to 13. 2. 02.	Do.	2½″ 2″	do.	17,010	29. 11. 02.	6,318	10,692	628·6
I.	5 to 10A	—. 11. 01 to 14. 2. 02.	Do.	2″	do.	44,830	10. 12. 02 to 21. 2. 03.	19,347	25,483	568·4
Total, Gronud, ...						123,091	–	65,417	57,674	468·5

Tralee Oysters (1st Consignment) 2nd Year.

II.	11	—. 1. 03 to 7. 7. 03.	Tralee, Relaid.	3″	Ground.	901	13. 10. 03.	570	331	367·4
II	12 to 14	3. 10. 02 to 4. 2. 03.	Do.	2½″	do.	27,899	13. 10. 03 to 9. 11. 03.	15,109	12,790	458·4
II.	15, 16	9. 10. 02 to 21. 2. 03.	Do.	2″	do.	16,279	9. 10. 03. to 9. 11. 03.	8,422	7,857	482·6
Total, Ground, ...						45,079	–	24,101	20,978	465·4
III.	17 to 19	13–18. 12. 02.	Tralee, Relaid.	2½″	Caisses.	1,800	15. 9. 03. to 9. 11. 03.	1,200*	605	336·1
III.	20	18. 10. 02.	Do.	2½″	Laying beside Caisse.	600	9. 11. 03.	222	378	630·0
Total, Caisses, ...						1,800	–	1,200*	605	336·1
Total, Ground beside Caisse, . .						600	–	222	378	830·0

Tralee Oysters (2nd Consignment) 1st Year.

Reference. Table.	Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates† of Raising.	Numbers Raised (Living).	Total Losses, including Dead and Missing. Number.	Total Losses, including Dead and Missing. Loss per 1,000 laid.
IV.	13. 12. 02 to 13. 1. 03.	Tralee, Direct.	2½″	Caisses.	2,365	9. 9. 03. to 25. 10. 03.	1,871	494	208·9
IV.	13. 12. 02 to 13. 1. 03.	Do.	2½″	Ground beside Caisses.	1,000	9. 9. 03.	587	413	413·0
IV.	12–13. 1. 03.	Do.	2″	Caisses.	1,800	10. 9. 03 to 30. 10. 03.	1,423	377	209·4
IV.	12–13. 1. 03.	Do.	2″	Gronnd beside Caisses.	400	9. 9. 03 to 30. 10. 03.	253	147	367·5
Total, Caisses, ...					4,165	–	3,294	871	209·1
Total, Ground beside Caisses, .					1,400	–	840	560	400·0

* Includes an excess of 5.
† Only the more important dates are given ; for full particulars see Reference given in Column 1.

Clarinbridge Oysters (1st Consignment) 1st Year.

Reference.		Dates of	Quality.	Size.	How Laid.	Number.	Dates of	Numbers Raised	Total Losses, including Dead and Missing.	
Table.	No.	Laying.					Raising.*	(Living).	Number.	Loss per 1,000 laid.
V.	1 to 2A	27. 3. 02.	Clarin-bridge, Direct.	3″	Ground.	762	17. 10. 02 to 4. 11. 02.	451	311	408·1
V.	3 to 4A	27. 3. 02.	Do.	2½″	do.	2,356	18. 10. 02 to 3. 11. 02.	1,853	503	213·5
V.	5 to 6A	27. 3. 02.	Do.	2′	do.	5,346	3-5. 11. 02.	2,455	2,891	540·8
Total, Ground, ...						8,464	–	4,759	3,705	437·7

Clarinbridge Oysters (1st Consignment) 2nd Year.

VI.	7 and 10	18. 10. 02 and 5. 11. 02.	Clarin-bridge, Relaid.	{ 3″ 2½″ 2″ }	Ground.	1,244	4. 11. 03.	526	718	577·2
VI.	8 and 11	3-4. 11. 02.	Do.	2½″	do.	747	3. 11. 03.	247	500	669·3
VI.	9 and 12	4. 11. 02.	Do.	2″	do.	1,522	3-13. 11. 03.	632	890	584·8
Total Ground, ...						3,513	–	1,405	2,108	600·1

Clarinbridge Oysters (2nd Consignment) 1st Year.

Reference.	Dates of	Quality.	Size.	How Laid.	Number.	Dates of	Numbers Raised	Total Losses, including Dead and Missing.	
Table.	Laying.					Raising.	(Living).	Number.	Loss per 1,000 laid.
VII.	12-14. 1. 03.	Clarin-bridge, Direct.	2¼″	Caisses.	1,800	10. 9. 03 to 15. 10. 03.	1,611	189	105·0
VII.	12-14. 1. 03.	Do.	2¼″	Ground beside Caisses.	600	9. 9. 03 to 17. 10. 03	496	104	173·3
VII.	12-13. 1. 03.	Do.	2″	Caisses.	2,700	9. 9. 03 to 25. 10. 03.	2,307	393	145·6
VII.	12-13. 1. 03.	Do.	2″	Ground beside Caisses.	600	9. 9. 03 to 25. 10. 03.	401	199	331·7
Total, Caisses, ...					4,500	–	3,918	582	129·3
Total, Ground beside Caisses, .					1,200	–	897	303	252·5

* Only the more important dates are given; for full particulars see Reference given in Column 1.

Auray Oysters (1st Consignment), 1st Year.

Reference. Table.	No.	Dates of Laying.	Quality.	Size.	How Laid.	Number.	*Dates of Raising.	Numbers Raised (Living).	Total Losses, including Dead and Missing. Number.	Loss per 1,000 Laid.
VIII.	4, 5	19. 12. 01.	Auray, 5–6 cm. Direct.	2½″ 2″	Ground.	4,500	7. 10. 02 to 25. 11. 02.	1,922	2,578	572·9
VIII.	1 and 3	19. 12. 01.	Do.	2″	Do.	3,700	22. 11. 02 to 16. 1. 03.	1,814	1,886	509·7
		Total, Ground,				**8,200**	–	**3,736**	**4,464**	**544·4**
VIII.	8 to 10	19. 12. 01.	Auray, 4–5 cm. Direct.	2″ 1½″	Ground.	11,000	6. 10. 02 to 27. 1. 03.	7,942	3,058	278·0
VIII.	6	19. 12. 01.	Do.	1½″	Do.	5,000	8. 10. 02	1,354	3,646	729·2
		Total, Ground,				**16,000**	–	**9,296**	**6,704**	**419·0**
VIII.	11 to 13 and 15	19. 12. 01.	Auray. 2½–4 cm. Direct.	1½″† 1″	Ground.	29,217 [a]	18. 6. 02 to 12. 2. 03.	5,850 [a]	23,367	799·8
		Total, Ground,				**29,217 [a]**	–	**5,850 [a]**	**23,367**	**799·8**
VIII.	16, 17	19. 12. 01.	Auray. Direct. Mixed trade sizes.	–	Ground.	4,000	3. 1. 03 to 30. 1. 03.	1,491	2,509	627·3
VIII.	2, 7, 14, and 17A	–. 5. 02.	Auray. Direct. Mixed trade sizes transferred from Red Bank.	–	Do.	7,700 [b]	6. 10. 02.	932 [c]	6,768	879·0
		Total, Ground,				**11,700**	–	**2,423**	**9,277**	**792·9**
IX.	29	30. 1. 02 and 10. 3. 02.	Auray, 2½–4 cm.	1″	Caisse.	1,800	28. 10. 02.	1,514	286	158·9
IX.	30, 31	5. 2. 02 and 10. 3. 02.	Do.	1½″ 1″	Caisses.	3,100	3–30. 10. 02.	2,917 [d]	186	60·0
IX.	32	31. 1. 02 and 10. 3. 02.	Do.	1½″ 1″	Do.	1,800	13. 3. 03.	1,654	146	81·1
		Total, Caisses,				**6,700**	–	**6,085 [d]**	**618**	**92·2**

* Only the more important dates are given; for full particulars see Table and Ref. Nos. given in column 1.

[a] Exclusive of oysters transferred in January and March, 1902, to caisses, for which see Ref. Nos. 29–32.

[b] Total number originally laid on Red Bank, exclusive of 1,300 transferred to caisse, see Ref. No. 14, note *d*.

[c] Total number raised of oysters transferred from Red Bank to Arklow 6, see Ref. No. 17A. This number, 932, also includes 40 oysters raised from Red Bank in September, 1903, see Ref. No. 2.

[d] Includes an excess of 3 oysters on number laid.

† See note (*) on Table VIII., as to size of these oysters.

AURAY OYSTERS (1ST CONSIGNMENT), 2ND YEAR.

Reference. Table.	Reference. No.	Dates of Laying.	Quality.	Size.	How Laid.	Number.	*Dates of Raising.	Numbers Raised. (Living).	Total Losses, including Dead and Missing. Number.	Total Losses, including Dead and Missing. Loss per 1,000 Laid.
IX.	18	—. 12. 02.	Auray, 5–6 cm. Relaid.	2½″	Ground.	200	17. 9. 03.	75	125	625·0
IX.	19	—. 12. 02.	Do.	2″	Do.	200	6. 11. 03.	21	179	895·0
		Total, Ground,				**400**	–	**96**	**304**	**760·0**
IX.	20, 21	—. 12. 02	Auray, 4–5 cm. Relaid.	2½″	Ground.	400	6. 11. 03.	124	276	690·0
IX.	22	—. 12. 02.	Do.	2″	Do.	200	6. 11. 03.	91	109	545·0
IX.	25, 25A	29. 10. 02 to 14. 11. 02.	Do.	2½″	Do.	646[a]	25. 7. 03.	300[a]	346	535·6
IX.	25B	25. 7. 03.	Do.	(2½″)	Caisse.	300	17. 9. 03.	290	10	33·3
IX.	25C	20. 12. 02.	Do.	2½″	Do.	600[a]	2. 10. 03.	521[b]	86	143·3
		Total, Ground,[c] **Total, Caisses,[c]**				**1,246** **900**	– –	**515** **811[b]**	**731** **98**	**586·7** **106·7**
IX.	23	—. 12. 02.	Auray, 2½–4 cm. Relaid.	2″	Ground.	1,450	20. 10. 03.	433	1,017	701·4
IX.	24	—. 12. 02.	Do.	1½″	Do.	200	6. 11. 03.	31	169	845·0
X.	30A, 31A	3. 10. 02.	Auray, 2½–4 cm. Relaid ex Caisses.	3″ 2½″ 2″ 1½″ 1″	Do.	2,948	3. 10. 03 to 6. 11. 03.	201	2,747	931·8
X.	29A	28. 10. 02.	Auray, 2½–4 cm. Relaid ex Caisses.	2″	Caisse.	458	17. 9. 03.	364[d]	99	216·2
X.	29A	28. 10. 02.	Do.	1½″	Do.	835	17. 9. 03.	574	261	312·6
		Total, Ground, **Total, Caisses,[e]**				**4,598** **1,293**	– –	**865** **938[d]**	**3,933** **360**	**855·4** **278·4**
IX.	26	6. 10. 02 to 11. 2. 03.	Auray. Relaid. Mixed trade sizes.	2½″	Ground.	2,228	15–16. 10. 03.	1,328	900	403·9
IX.	27	6. 10. 02 to 12. 2. 03.	Do.	2″	Do.	9,698[f]	20. 10. 03.	3,705	5,903	614·4
IX.	28	5. 10. 02 to —. 12. 02.	Do.	1½″	Do.	1,988[g]	20. 10. 03.	130	1,858	934·6
		Total, Ground,				**13,824**	–	**5,163**	**8,661**	**626·5**

* Only the more important dates are given; for full particulars see Table and Ref. Nos. given in column 1.
a Exclusive of 800 transferred in December, 1902, to caisse and ground, see Ref. Nos. 20 and 25C.
b Includes an excess of 7 oysters
c See above for periods for which oysters were laid in caisses and on the ground.
d Includes an excess of 5 oysters.
e See also Table X., Ref. No. 32A, Caisse XXV., XXVI., XXVII., which is not included here for the reasons stated in notes.
f Includes 912 Arcachon oysters.
g Includes 47 Whitstable oysters.

AURAY OYSTERS (2ND CONSIGNMENT) 1ST YEAR.

Reference.		Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.*	Numbers Raised (Living).	Total Losses, including Dead and Missing.	
Table.	Caisse Nos.								Number.	Loss per 1,000 laid.
XI.	II.	18. 4. 03.	Auray, 5–6 cm. Direct.	2″	Caisses.	957	29. 9. 03.	896 [a]	68	71·1
XI.	IX. to XI.	22. 4. 03	Do.	$1\frac{1}{4}$″	do.	5,768	11–29. 9. 03.	5,181 [b]	591	102·5
Total, Caisses, ...						**6,725**	-	**6,077** [c]	**659**	**98·0**
XI.	XIII. and XIV.	23. 4. 03.	Auray, 4–5 cm. Direct.	$1\frac{1}{2}$″	Caisses.	7,411	11–30. 9. 03.	6,594 [d]	864	116·6
XI.	I.	18. 4. 03.	Do.	1″	do.	2,137	17. 9. 03.	1,797	340	159·1
Total, Caisses, ...						**9,548**	-	**8,391** [d]	**1,204**	**126·1**
XI.	XVIA.	28. 4. 03.	Auray, $2\frac{1}{2}$–4 cm. Direct.	$1\frac{1}{2}$″	Caisses.	910	17. 9. 03.	805	105	115·4
XI.	XVII. to XIX.	28–29. 4. 03.	Do.	1″	do.	9,216	17. 9. 03. to 2. 10. 03.	8,596	620	67·3
Total, Caisses, ...						**10,126**	-	**9,401**	**725**	**71·6**

a Includes an excess of 7. b Includes an excess of 4. c Includes an excess of 11. d Includes an excess of 47.
* Only the more important dates are given; for full particulars see Table and Ref. No. given in Col. 1.

ARCACHON OYSTERS (1ST CONSIGNMENT) 1ST YEAR.

Reference.		Dates of Laying.*	Quality.	Size.	How Laid.	Number.	Dates of Raising.*	Numbers Raised (Living).	Total Losses, including Dead and Missing.	
Table	No.								Number	Loss per 1,000 laid.
XII.	1	27. 3. 02.	Arcachon, 1st Quality. Direct.	2½″	Ground.	7,350	24. 10. 02 to 19. 11. 02.	5,421	3,668	308·5
XII.	2	27. 3. 02.	Do.	2″	do.	4,540	24–27. 10. 02	2,801		
Total, Ground, ...						**11,690**	–	**8,222**	**3,666**	**308·5**
XII.	3	27. 3. 02.	Arcachon, 2nd Quality. Direct.	2½″	Ground.	3,275	16. 10. 02.	1,055	2,220	677·9
XII.	4	27. 3. 02.	Do.	2″	do.	6,600	21–25. 11. 02.	3,779	2,821	427·4
Total, Ground, ...						**9,875**	–	**4,634**	**5,041**	**510·5**

ARCACHON OYSTERS (1ST CONSIGNMENT) 2ND YEAR.

Reference.		Dates of Laying.*	Quality.	Size.	How Laid.	Number	Dates of Raising.*	Numbers Raised. (Living).	Total Losses, including Dead and Missing.	
Table.	No.								Number	Loss per 1 000 laid.
XIII.	5	—. 12. 02.	Arcachon, 1st Quality. Relaid.	2″ and under.	Ground.	200	6. 11. 03.	52	148	740·0
XIII.	6	—. 12. 02.	Arcachon, 1st and 2nd Qualities. Relaid.	2½″	do.	200	6. 11. 03.	26	174	870·0
Total, Ground, ...						**400**	–	**76**	**322**	**605·0**
XIII.	10	13. 12. 02.	Arcachon, 1st and 2nd Qualities. Relaid.	2″ and under.	Caisse.	600	15. 9. 03.	407	193	321·7
Total, Caisse, ...						**600**	–	**407**	**193**	**321 7**
XIII.	7	24. 10. 02 to 25. 11. 02.	Arcachon, 1st and 2nd Qualities. Relaid.	3″ 2½″	Gronnd.	739	16. 10. 03.	210	529	715·8
XIII.	8	24. 10. 02 to 25. 11. 02.	Do.	2½″	do.	4,303†	6–9. 10. 03.	2,610	1,693	393·4
XIII.	8	24. 10. 02 to 25. 11. 02.	Arcachon, 1st and 2nd Qualities. Relaid. And Isle of Wight. Relaid,	2″ and under. 3″ 2½″ 2″	do.	5,683‡	6–9. 10. 03.	2,640	3,043	535·5
Total, Ground, ...						**10,725**	–	**5,460**	**5,265**	**490·9**

* Only the more important dates are given; for full particulars see Table and Ref. No. given in Col 1.
† Exclnding 200 removed for sample laying—see Ref. No. 6.
‡ Excluding 600 removed to Caisse X., XI., XII.—see Ref. No. 10.

ARCACHON OYSTERS (2ND CONSIGNMENT) 1ST YEAR.

Reference.		Date of Laying.	Quality.	Size.	How Laid.	Number.	Date of Raising.	Numbers Raised (Living).	Total Losses, including Dead and Missing.	
Table.	Caisse Nos.								Number.	Loss per 1,000 Laid.
XIV.	XV.	25. 4. 03.	Arcachon, 1st Quality. Direct.	2½″	Caisses.	775	2. 10. 03.	622[a]	155	200·0
XIV.	VI. to VIII.	22. 4. 03.	Do.	2″	Do.	3,595	11–29. 9. 03.	2,824[b]	820	228·1
Total, Caisses,						4,370	–	3,446[c]	975	223·1
XIV.	III. to V.	20. 4. 03.	Arcachon, 2nd Quality Direct.	2″	Caisses.	4,343	11–29. 9. 03.	3,075[d]	1,285	295·9
XIV.	XII.	22. 4. 03.	Do.	1½″	Do.	1,628[g]	15. 9. 03.	1,119[e]	511	313·9
Total, Caisses,						5,971	–	4,194[f]	1,796	300·8

a Includes an excess of 2.
b " " 49.
c " " 51.
d " " 17.
e " " 2.
f " " 19.
g " 80 Arcachon, 1st quality, 1½″.

"Whitstable Natives," or Kentish Knock (1st Year).

Reference.		Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.*	Numbers Raised (Living).	Total Losses, including Dead and Missing.	
Table.	No.								Number.	Loss per 1,000 Laid.
XV.	1	20. 5. 02.	Kentish Knock. Direct.	3″	Ground.	85	1. 11. 02 to 2. 12. 02.	77	8	94·1
XV.	2	20. 5. 02.	Do.	2½″	do.	150	31. 10. 02 to 4. 11. 02.	149	1	6·7
XV.	3	20. 5. 02.	Do.	2″	do.	600	1-4. 11. 02.	521	79	131·7
XV.	4	20. 5. 02.	Do.	1½″ and under.	do.	1,000	1-4. 11. 02.	708	292	292·0
		Total, Ground,				1,835	-	1,455	380	207·1

"Whitstable Natives," or Kentish Knock (2nd Year).

XVI.	5 and 5A	1. 11. 02 to 2. 12. 02.	Kentish Knock. Relaid.	Mixed Sizes.	Ground.	920	6. 11. 03.	177	743	807·6
		Total, Ground,				920	-	177	743	807·6

Dutch Oysters (1st Year).

Reference.		Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.*	Numbers Raised (Living).	Total Losses, including Dead and Missing.	
Table.	No.								Number.	Loss per 1,000 Laid.
XXI.	1	26. 4. 02.	Dutch.	2½″	Ground.	660†	31. 10. 02 to 16. 11. 02.	494	166‡	251·5
XXI.	2	26. 4. 02.	Do.	2″	do.	350†	31. 10. 02 to 14. 11. 02.	212	138‡	394·3
		Total, Ground,				1,010	-	706	304	301·0

Dutch Oysters (2nd Year).

XXII.	3	31. 10. 02 to 16. 11. 02.	Dutch. Relaid.	3″ 2½″	Ground.	82	20. 10. 03.	51	31	378·0
XXII.	4	31. 10. 02.	Do.	2″	do.	424	20. 10. 03.	81	343	809·0
		Total, Ground,				506	-	132	374	739·1

* Only the more important dates are given, for full particulars see Table and Ref. Nos. given in Column 1.
† Numbers received in April, 1902, and laid temporarily till June. See Reference, Column 1.
‡ Losses are calculated from date of receipt in April.

Falmouth Oysters, 1st Year.

Reference. Table	No.	Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.†	Numbers Raised (Living)	Total Losses, including Dead and Missing. Number.	Loss per 1,000 Laid.
XVII.	1	3. 5. 02.	Falmouth Direct.	3″	Ground,	*60	3. 11. 02	44	16	266·7
XVII.	2	3. 5. 02.	Do.	2½″	Do.	*1,770	3-4. 11. 02	1,185	585	330·5
XVII.	3	3. 5. 02.	Do.	2″	Do.	*3,285	30. 10. 02 to 4. 11. 02	2,510	775	235·9
		Total, Ground,		.	. .	5,115	–	3,739	1,376	269·0

Falmouth Oysters, 2nd Year.

Reference. Table	No.	Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.†	Numbers Raised (Living)	Total Losses, including Dead and Missing. Number.	Loss per 1,000 Laid.
XVIII.	4	30. 10. 02 to 3. 11. 02.	Falmouth Relaid.	3½″ 3″	Ground,	73	20. 10. 03	30	43	589·0
XVIII.	5	30. 10. 02 to 4. 11. 02.	Do.	2½″	Do.	1,688	20. 10. 03	613	1,075	636·8
XVIII.	6	30. 10. 02 to 4. 11. 02.	Do.	2″ 1½″	Do.	1,537	20. 10. 03	352	1,185	771·0
		Total, Ground,		.	. .	3,298	–	995	2,303	698·3

Isle of Wight Natives, 1st Year.

Reference. Table	No.	Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.†	Numbers Raised (Living)	Total Losses, including Dead and Missing. Number.	Loss per 1,000 Laid.
XIX.	1	18. 1. 02.	Isle of Wight Direct.	3″	Ground,	2,182	9. 12. 02.	1,577	605	277·3
XIX.	2	18. 1. 02.	Do.	2½″	Do.	2,519	9. 12. 02.	1,196	1,323	525·2
XIX.	3, 4	27. 1. 02.	Do.	2½″ 2″	Do.	3,264	29. 1. 03.	1,353	1,911	585·5
XIX.	5	27. 1. 02.	Do.	2″	Do.	1,000	5. 11. 02.	690	310	310·0
		Total, Ground,		.	. .	8,965	–	4,816	4,149	462·7

Isle of Wight Natives, 2nd Year.

Reference. Table	No.	Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.†	Numbers Raised (Living)	Total Losses, including Dead and Missing. Number.	Loss per 1,000 Laid.
XX.	6	9. 12. 02 to 29. 1. 03.	Isle of Wight Relaid.	3″ 2½″	Ground,	3,334	6. 11. 03.	819	2,515	754·3
XX.	7, 7A	9. 12. 02 to 29. 1. 03.	Do.	3½″ 2″	Do.	156	6. 11. 03.	60	96	615·4
		Total, Ground,		.	. .	3,490	–	879	2,611	748·1

* Actual numbers received in May. These oysters were not finally laid until June 12. For details of numbers laid see Table and Ref. Nos. given in column 1.

† For full particulars of dates of raising see Table and Ref Nos given in column 1.

SUMMARY SHOWING LOSSES OF OYSTERS LAID AT BALLYNAKILL.

MISCELLANEOUS LAYINGS, 1902.

Reference.		Date of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.*	Numbers Raised (Living).	Total Losses, including Dead and Missing,	
Table.	No.								Number.	Loss per 1,000 Laid.
XXIII.	1	—. 4. 02.	Tralee. Direct.	3″	Ground.	131	3. 10. 02.	119	12	91·6
XXIII.	2, 3	—. 4. 02.	Do.	2½″	Do.	1,123	17. 10. 02.	1,062	61	54·3
XXIII.	4, 5	—. 4 02.	Do.	2″	Do.	1,202	1-17. 10. 02.	1,022	180	149·8
		Total, Ground,				2,456	-	2,203	253	103·0
XXIII.	6	8. 4. 02.	Clarinbridge. Relaid at Burren.	3″	Ground.	90	20. 9. 02 to 3. 10. 02.	83	7	77·8
XXIII.	7	8. 4. 02.	Do.	2½″	Do.	90	19. 9. 02 to 3. 10. 02.	80	10	111·1
XXIII.	8	8. 4. 02.	Do.	2″	Do.	90	3. 10. 02.	84	6	66·7
		Total, Ground,				270	-	247	23	85·2
XXIII.	9	8. 4. 02.	Arcachon. 1st quality. Relaid at Burren.	2½″	Ground.	90	28. 9. 02 and 18. 10. 02.	82	8	88·9
XXIII.	10	8. 4. 02.	Do.	2″	Do.	90	18. 10. 02.	68	22	244·4
XXIII.	11	8. 4. 02.	Arcachon. 2nd quality Relaid at Burren.	2½″	Do.	90	18. 10. 02.	88	2	22·2
XXIII.	12	8. 4. 02.	Do.	2″	Do.	90	3. 10. 02.	85	5	55·6
		Total, Ground,				360	-	328	37	102·8

* Only the more important dates are given; for full particulars see Table and Ref. No. given in Col 1

TRALEE, CLARINBRIDGE, AURAY, AND ARCACHON OYSTERS AT BALLYNAKILL, 1903–04.

Reference: Table.	Reference: No.	Dates of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.*	Number Raised (Living).	Total Losses, including Dead and Missing: Number.	Total Losses, including Dead and Missing: Loss per 1,000 Laid.
Tralee Oysters.										
XXIV.	1, 2	28. 1. 03.	Tralee, Direct.	2″	Caisses.	1,629	4–5. 11. 03.	1,469 [a]	163	100·1
XXIV.	4	28. 1. 03	Do.	1½″	do.	214	4. 11. 03.	95	119 [b]	556·1
XXIV.	3	28. 1. 03.	Do.	2″	Ground by Caisse.	200	5. 11. 03.	158	42	210·0
Total, Caisses,						**1,843**	–	**1,564** [a]	**282**	**153·0**
Total, Ground,						**200**	–	**158**	**42**	**210·0**
Clarinbridge Oysters.										
XXIV.	5	23. 1. 03.	Clarinbridge, Direct.	3″, 2½″, 2″	Caisses.	817	4. 11. 03.	682	135	165·2
XXIV.	6, 7	28–30. 1. 03.	Do.	2″	do.	1,815	4–16. 11. 03.	1,481	334	184·0
Total, Caisses,						**2,632**	–	**2,163**	**469**	**178·2**
XXIV.	8	13. 3. 03.	Clarinbridge Dwarfs, Relaid at Burren.	2½″, 2″	Caisses.	100	5. 11. 03.	90 [c]	11	110·0
Auray Oysters. Laid at Ballynakill, 1903; transferred to Ardfry, 1904.										
XXV.	1	10. 4. 03.	Auray, 5–6 cm., Direct.	2″	Caisses.	1,007	18. 3. 04.	682	325	322·7
XXV.	2	10–28. 4. 03.	Do.	1½″	do.	5,555	16. 3. 04. to 2. 4. 04.	4,484	1,071	192·8
Total, Caisses,						**6,562**	–	**5,166**	**1,396**	**212·7**

* Only the more important dates are given, for full particulars see Table and Ref. No. given in column 1.

[a] Includes an excess of 3. [b] See note e, Table XXIV.

[c] Includes an excess of 1.

TRALEE, CLARINBRIDGE AURAY, AND ARCACHON OYSTERS AT BALLYNAKILL, 1903–04—*continued.*

Reference.		Date of Laying.	Quality.	Size.	How Laid.	Number.	Dates of Raising.*	Numbers Raised (Living).	Total Losses, including Dead and Missing.	
Table.	No.								Number.	Loss per 1,000 Laid.
				AURAY OYSTERS—*continued.*						
XXV.	3	9. 4. 03.	Auray, 4–5 cm., Direct.	2″	Caisses.	123	1. 4. 04.	90	33	268·3
XXV.	4	10–28. 4. 03.	Do.	1½″	do.	7,103	18. 3. 04 to 1. 4. 04.	5,866[a]	1,356	190·9
XXV.	5	11. 4. 03.	Do.	1″	do.	1,530	18. 3. 04 and 1. 4. 04.	1,064[b]	472	308·5
		Total Caisses,	.	.	.	**8,756**	–	**7,020[c]**	**1,861**	**212·5**
XXV.	6	25. 6. 03.	Auray, 3–4 cm., Direct.	1½″	Caisses.	655	6. 2. 04.	392[d]	274	418·3
XXV.	7	25–26. 6. 03.	Do.	1″	do.	7,911	13. 2. 04 to 12. 4. 04.	5,417[e]	2,522	318·8
XXV.	8	25. 6. 03.	Do.	Under 1″	do.	567	12. 4. 04.	146	421	742·5
		Total, Caisses,	.	.	.	**9,133**	–	**5,955[f]**	**3,217**	**352·2**
ARCACHON OYSTERS. LAID AT BALLYNAKILL, 1903; TRANSFERRED TO ARDFRY, 1904.										
XXVI.	1	13–14. 4. 03.	Arcachon, 1st quality, Direct.	2½″	Caisses.	938	16–29. 3. 04.	295	643	685·5
XXVI.	2	13–14. 4. 03.	Do.	2″	do.	4,356	18. 3. 04 to 7. 4. 04.	2,776[g]	1,765	405·2
XXVI.	3	28. 4. 03.	Do.	1½″	do.	172	29. 3. 04.	90	82	476·7
		Total, Caisses,	.	.	.	**5,466**	–	**3,161[g]**	**2,490**	**455·5**
XXVI.	4	15. 4. 03.	Arcachon, 2nd quality, Direct.	2″	Caisses	3,025	16–29. 3. 04.	2,180[h]	1,300	429·8
XXVI.	5	25. 4. 03.	Do.	2½″	do	(24)[i]	–	–	(4)	
XXVI.	6	28. 4. 03.	Do.	1½″	do.	(960)[i]	–	–	(836)[k]	
		Total, Caisse (2″),	.	.	.	**3,025**	–	**2,180[h]**	**1,300**	**429·8**

* Only the more important dates are given; for full particulars see Table and Ref. No. given in column 1.

NOTE.—It is not possible to state with certainty how the excesses in Auray and Arcachon oysters arise. Both consignments, especially the latter, suffered from the effects of gales, the caisses being in exposed positions. It seems possible that some of the missing (see Tables XXV. and XXVI.) may have been put back into caisses other than their own. See also pp. 291-3.

a Includes an excess of 119.
b ,, ,, 6.
c ,, ,, 125.
d ,, ,, 11.
e ,, ,, 28.
f Includes an excess of 39.
g ,, ,, 185.
h ,, ,, 455.
i See note *c*, Table XXVI.
k See notes *d* and *e*, Table XXVI.

VII.—Hypothetical Profits and Losses.

While details of growth, mortality, etc., are to be found in the tables, a short review of the apparent financial results will probably be of interest. Our operations having been of an experimental nature and not carried out as a commercial enterprise, it is not possible for us to give net figures. The amount which was paid in wages and in subsidy for use and protection of the ground occupied is, of course, on record, but much of the cost was incurred in sorting, measuring, and weighing stock to a degree which, while necessary for our observations, is far beyond what would have been required in an ordinary relaying undertaking. Further expense was entailed by the separate laying and care of stock after division by sizing and weighing, and in the comparative trial of different sections of the ground.

As to the practical cost of care of stock there is no means of arriving at a figure of universal application. The cost of the bed alone is variable. If purchased there will be the interest on the purchase money; if obtained under license with the consent of owners or occupiers of adjoining lands, something will probably have been payable in respect of such consents; if obtained by the licensee on the foreshore of his own lands or below low-water mark, the cost will have been practically *nil*.

The labour bill will vary with the circumstances of the cultivator more than with the amount of stock handled. Watching is an item which varies with the ethics of the locality, as much perhaps as with the facilities for disposing of plunder. On the west coast we do not think the necessity for watching will often arise, except in regard to layings near public fisheries during the period when the latter are being dredged.*

A small farmer, having a laying adjoining his farm, might perhaps handle stock up to about 100,000, especially if he enjoyed the assistance of a family, however weak, since much of the work of a laying between tide-marks or accessible by wading at low-water springs can quite well be undertaken by women and children. A proprietor, or strong farmer, compelled to keep a certain number of men constantly on the pay-sheet, might be able to utilise their services in oyster culture on a considerable scale without undue interference with the claims of agriculture, since during the warmer months of the year oysters demand little except to be left alone.

On the other hand, if an oyster bed is acquired by a person who cannot immediately supervise its culture, and who has not servants able to devote part of their time to it, the cost will be much greater. It is presumed that the oysters are to be laid down for commercial purposes, and not merely to supply the owner's household. Any considerable undertaking will require at least two labourers, on account of the heavy weights to be handled when receiving and raising stock, and despatching same to market. Experience will soon show that if capable men can be found they must be kept permanently on the pay-sheet, because casual labour in oyster-culture without the support of a skilled permanent staff is apt to prove expensive. Further, they must be paid something more than the local wage of agricultural labourers, for no man will work in the water if he can earn as much money on dry land. If the bed has to be worked by dredge the cost of and upkeep of boat and dredges have to be considered, and, of course, in all cases the cost of despatching stock to market varies according to local railway facilities. The cost of supervision and clerical work, which cannot be left to the labourers, will be found a further charge, not easy of general estimate, and not avoidable.

It is obvious that the staff, though constantly drawing pay, cannot be constantly employed in handling oysters, but to some extent their

* At Burren our experiments were safe-guarded by an elaborate system of watching, and at Ardfry a similar system is continued. At Ballynakill, where the Marine Laboratory had long been recognised as a friendly institution, it was not deemed necessary to watch at all and no one interfered with our layings, though freely exposed at low-water of every spring tide.

spare time can be employed in making boxes for consignment, and in making and repairing caisses, if caisse-culture be a part of the programme.

Under all the circumstances of culture referred to above the same difficulty in estimating cost occurs, because the care of 100,000 oysters costs not less than the care of a very much larger number, and in the absence of a golden rule to success, the personal equation of the supervisor may entirely influence the result.

In presenting the figures given below we assume that the cultivator starts with an assured market, for as much good ware as he can produce, by direct sale to the consumer or to retail purveyors. It is not to be assumed, because a relayer has been able to dispose locally of a few hundreds or thousands at a high price, that it will pay him to enlarge his business. He may find that his output at the same price is capable of no expansion, and may be compelled to send his stock to a wholesale market, where it will fetch only what it may appear to be worth to the wholesale man, and will lose the special value which attaches to oysters received by the consumer direct from the unpolluted beds of the Irish west coast. While no reputable oyster merchant will touch stock from tainted sources, it is not to be supposed that any will admit that one brand of the goods which he offers is more free from risk of pollution than another. Consequently the west coast native will, if sold through wholesale dealers, have to compete for flavour and fatness with stock which may be more than its equal in one or both of these respects. In this connection an experience of our own may be of interest. We had occasion to import from various Irish beds of high repute consignments designed for a particular purpose. Comparing them with our own stock, the latter was found to be at least as good as any, and we knew the prices of all. Wishing to have an unprejudiced opinion, we sent a parcel of our own stock, carefully selected, to a Billingsgate merchant of undoubted character, and in due course received the proceeds of sale, and a report with which he was kind enough to furnish us. Sold in competition with the best English natives, our stuff fetched about half the price of the latter, and, having regard to relative fatness, weight of fish to weight of shell, and appearance, we cannot contend that the price was unduly low. No doubt the "natives" of the west coast and of Whitstable have different flavours, and some prefer one and some the other, but in effect we believe that the west coast oyster is valued by consumer or retailer chiefly on account of its known immunity from sources of pollution.* There is, therefore, we imagine, no present prospect of a satisfactory market except by direct sale to the consumer or to the retailer in whose house the west coast oyster has an assured position, and if a relayer cannot find in this way an outlet for all his stock, it may be better for him to sell at reduced price to a relayer with a larger connection than to consign to a wholesale market.

Our figures are not based upon actual sales. We did, in fact, sell a considerable number of oysters, and could have sold as many more as we chose, but needed the saleable stock for future spatting operations. The prices we have named are those at which we have reason to believe the oysters could have been sold, net,† to consumers or retailers, with a reduction made to cover a percentage of doubtful stock. We have classed as saleable any lot of oysters in which the shell measured by Auray gauge at least $2\frac{1}{2}''$‡ and in which the fish averaged at least 6 grm. A good fish§ may be anything from 6 to 12 grm., but a fish of the former weight, if fat, will pass muster, and, taking heavy with light, the lots were no doubt saleable to consumers and retailers, net, after payment of package and carriage, at the prices at which we have appraised them.

* Be it far from us to suggest that Whitstables, which we have had occasion to mention, are not equally immune.

† *i.e.*, after deduction of cost of packing and carriage.

‡ Except some few of the Clarenbridges which, though carrying a good fish, were only 2-inch in shell.

§ The fish-weight does not include the weight of the liquor in shell, see pp. 224-5.

Tralees.—The first laying, made in the winter of 1901-2, comprised, exclusive of samples used for examination, 120,944 oysters, costing, at from 15*s.* to 17*s.* 6*d.* per 1,260, about £81. In the autumn of 1902 38% were marketable, 15% were unmarketable, and 48% were dead or lost. The marketable oysters were a very fine lot, and counting larger with smaller, were certainly value for 7*s.* per hundred, after allowing for cost of package, carriage, etc., *i.e.*, £159 10*s.* 6*d.*, leaving a balance of £78 10*s.* 6*d.* on the right side. Including a long journey in carts, carriage and incidentals brought the first cost up to something less than £1 per 1,260, which reduces the balance to about £66 10*s.* 6*d.*, and this is, as in all cases, subject, for reduction to net profit, to the cost of care.

Actually the balance on the transaction would have been somewhat greater than this, as we have classed among "samples" a lot of 1,000 of the very best oysters, which were not raised at stock-taking with the others.

All this consignment consisted of oysters as received direct from the Tralee public bed, and included some which were immediately saleable, though not at a high price, and many others which were of less than the legal size. The bailiff appointed in the following season has practically abolished the exportation of under-sized oysters, so that though the price of direct Tralees is now much higher than in 1902* the purchaser gets a much larger proportion of large stock per hundred.

The 15% of stock classed as unmarketable at the end of our first season consisted of 17,692 oysters all of 2″ size. They might, perhaps, have been disposed of for soup and cooking purposes at 2*s.* per 100, or about £17 10*s.* Relaid for another season, but raised rather early, they yielded (see Table II., Refs. 15, 16) 4,059 marketable, and 4,368 non-marketable, the remainder being dead or missing. The marketable ones may be valued at 7*s.* per hundred, or £14 3*s.* 6*d.* Their number might perhaps have been increased if the raising had taken place a month or two later, but this is doubtful. To the £173 14*s.* 0*d.* already supposed to have been received for the marketable oysters in the two years, one can at most add £4 7*s.* 0*d.* as the selling value of the unmarketable left in hand at 2*s.* per hundred, though we have, in our private capacities, bought worse oysters at a much higher price.

The second consignment of Tralees was purchased from consignee on arrival from the public bed, the vendor reserving for his own use all the larger oysters. For the remainder we paid £1 per 1,260, carriage free. Details of size appear in the tables.

Exclusive of samples, 4,165, placed in caisses, cost £3 6*s.* 1*d.*, and at stock-taking early in the following autumn yielded marketable oysters 46% or 1,919, valued at £6 14*s.* 0*d.*, unmarketable 33% or 1,365, possibly value for £1 8*s.* 0*d.* 1,400 laid on the ground and raised at the same times as the caisse lot cost £1 2*s.* 3*d.*, and produced marketable 48% or 665, value £2 6*s.* 7*d.*, and unmarketable 13% or 175, possible value about 3*s.* 6*d.* The loss in caisses amounted to 21%, and, on the ground, to 40%.

It will be seen that in all our dealings with Tralees, there was between gross cost and net sale prices a fair margin to defray expenses of care, and, perhaps, put something to net profit.

Clarenbridges.—The first consignment was received in the winter of 1901-2. The number, exclusive of samples, was 8,114, delivered free at £1 10*s.* 0*d.* per 1,260, for £9 13*s.* 2*d.* Clarenbridge is only about 16 miles from Burren, so the cost of carriage cannot have been much to the vendor,‡ and for stocking relayings at a distance the cost would, of course, come higher. This class of oyster is much like Tralees, but generally in rather better condition as to fish when raised from the public bed. Frequently, we think, the best oysters are skimmed off for sale for immediate consumption or as payment to the bailiffs, and our consignment probably represents the remnant after this process. The minimum

* About 30*s.* per 1,260 in season of 1904-5.

‡ 10*s.*, unless he used his own horse and cart.

size legally saleable is 3″, as measured by ring. Many such would only be $2\frac{1}{2}$″ by Auray gauge, but as we got a good many which only measured 2″ by Auray gauge, it may be supposed that the supervision of the bailiffs was not wholly effectual.

The oysters were laid on the ground, and at stock-taking in the autumn of 1902 yielded 2,324 or 29% "marketable," valued at 7s. per hundred, £8 2s. 8d., or £1 10s. 6d. less than the cost of the whole lot; 26%, 2,085 "unmarketable" may have been saleable for about £2 10s. The balance, 46%, is accounted for by loss.

The "unmarketables" were all derived from the oysters which measured 2″ when first laid.

The balance (*i.e.*, less samples) was relaid for another season and yielded 419 marketable, valued at £1 9s. 0d., and 487 unmarketable, possibly value for 10s.; the remainder, 1,234, were lost (see Table VI., Refs. 10-12). However, the value of the marketable oysters above is subject to a deduction of about 9s., as the layings (see Ref. 10) included 217 oysters already marketable when relaid. It will be seen that this consignment cost £9 13s. 2d., and at the most returned £10 12s. 8d., the profit (net except the cost of care on beds) being 19s. 6d. On a scale comparable to that of the Tralee operation it would have reached about £15.

The second consignment, laid early in 1903, cost £2 0s. 0d. per 1,260, delivered free; 4,500, costing £7 2s 10d., were laid in caisses, and in autumn yielded 3,090, or 69% marketable, value £10 16s. 4d., and 18% or 828 unmarketable, possibly value for 18s. 6d. The losses amounted to 13%. 1,200, costing £1 18s. 1d., were laid on the ground and yielded 701 or 58% marketable, value £2 9s. 0d., and 16% or 196 unmarketable, value about 4s. The losses were 25%.

The ground layings were small in number and, as check layings, received an amount of individual attention which could not have been bestowed upon a large laying; there is also the possibility that their numbers may have been slightly increased by oysters washed out of the uncovered caisses (see Tables IV. and VII.). Nevertheless, their return, if reduced to a common denominator with those of the caisse layings, is less satisfactory, though better than those of the ground layings of the first consignment. The caisse return, in figures comparable to the first consignment layings, is about £5 to the good.

With regard to the relative merits of the Clarenbridge and Tralee oysters, the preference must be, we think, given to the former if the prices were the same, but as stated before (see p. 325) the price of the Clarenbridges was almost double that of the Tralees. In the present season, 1904, the price of Tralees, as dredged, appears to be about 30s. per long thousand, but we do not know the current price of Clarenbridges. As the recent dredging appears to have been unsuccessful, it is probable that the price has risen considerably.

Apart from the question of price, the following points may be of interest to an intending purchaser: As the legal limit at Clarenbridge is 3″, and at Tralee $2\frac{1}{2}$″, both by the ring gauge, it is to be presumed that the purchaser of unsorted stock at the former place will obtain a larger proportion of immediately saleable oysters; part of his purchase-money may thus be recovered without delay.

There is little to chose between the two varieties in appearance,. The Clarenbridges are generally somewhat heavier in shell, though this cannot be reckoned an advantage. As regards the number of marketable oysters produced after a season's relaying, the figures are somewhat contradictory; in the first year of the experiment (1902) it was found that the Tralees produced about 10% more marketable oysters than did the Clarenbridges: in the second consignment (1903) the conditions were reversed, the Clarenbridges in caisses having 23% and in layings 10% more marketable oysters than similarly treated Tralees. The Clarenbridges of 1903 appeared to be a hardier lot, the losses in caisses and layings being 8% and 15% less than with the Tralees under the same conditions. It must, however, be remembered that the larger oysters had been removed from the Tralees (second consignment) prior to our purchase of them. (See *ante*, p. 325). The question really depends on

the current prices and on the quality of the oysters which have been dredged, and, perhaps, at Clarenbridge, where there are no regular wholesale agents, it is advisable to purchase on the spot.

Isle of Wights.—As already explained, these oysters were intended primarily for spatting, and we do not know their exact origin. Their history is, therefore, of no great importance to relayers. We laid 8,955,* costing at £1 per 1,000, delivered free, £8 19*s.* 1*d.*, and at the end of the first season raised 3,899 or 44% marketable, 10% not marketable, and lost 46%. Though fulfilling the requirements of size and weight the marketable stock was not of good quality, and we cannot appraise it at more than 5s. per hundred after cost of package and carriage. At this rate the marketable oysters were worth £9 15*s.*, and the 907 unmarketable may have been value for 18*s.* In all, the return was £10 13*s.*, against £8 19*s.* 1*d.*

Kentish Knocks.—The small consignment of this class, received on May 20, 1902, consisted, after deduction of samples, and some small oysters which got mixed with another lot, of 1,785, costing, at £1 per 1,000, £1 15*s.* 8*d.* The tables show that they were mostly of small size. At the autumn stock-taking they produced only 11% or 195 marketable. They were fair oysters, but not so good as Tralees and Clarenbridges, and we appraise them at 6s. per hundred, or about 12*s.* for the lot; 68% or 1,210 were unmarketable, and, as many were very small, 12*s.* might represent their possible saleable value for cooking, etc. The losses were 21% during the six months. The result shows a deficit of 11*s.* 8*d.* on the first year's laying, and the numbers available for the second year were not sufficient for practical purposes. It would appear that this class of oyster, in the sizes shown in the tables, does not offer occasion for profit on a single season's turnover, but it is to be noted that the stock seems hardy in comparison with others, and that our consignment was imported late in the season, after the oysters had begun to make new growth. In spite of our apparently unfavourable experience, we do not think that this class of oyster is unworthy the attention of relayers.

Dutch.—We imported only a small lot, which arrived at Burren on April 26, 1902, but owing to the miscarriage of a report, they were left on the dumping ground for some time before being transferred to suitable layings.

960, the number received living (less samples raised for examination), cost, at £1 8*s.* per 1,000, £1 6*s.* 11*d.*, and after being laid for the season yielded 13% or 127 marketable, valued, at 6*s.* per hundred, at 7*s.* 6*d.*, 32% were lost, and 55% or 529 unmarketable may have been worth 10*s.* None of our April importations did well, and they cannot be regarded as fair samples, but we incline to think that the Dutch are but poor growers on west coast beds. The sizes tried are detailed in Table XXI.

The shell is satisfactory in appearance, and the fish is good for its size. For rapid turnover full-grown Dutch would perhaps be quite a satisfactory investment.

Arcachons. First Quality (Tables XII. and XIII.)—11,515,† at 14*s.* 10*d.* per 1,000, cost us £8 10*s.* and carriage, which, as will be seen from the section of the Report dealing with this matter (p. 230) is an item which varies with the number imported and with the route. The sizes on importation are detailed in Table XII.

* Exclusive of samples and of some which were accidentally mixed with Tralees.

† This represents the gross number laid after deduction of samples raised for examination, &c., and of those found after the bed had been harrowed. See Table XII, note *d.*

At the end of the first season 24% or 2,714 were classed as marketable. but we do not put their net value at more than 4*s.* per hundred, or £5 8*s.* 7*d.* for the lot. 32% were lost, and the balance, 45% or 5,133, had, in our opinion, no saleable value. The bulk of them were relaid with the unmarketable of the second quality on Arklow 19 (see Table XIII., Ref. No. 9), but owing to a mistake when they were raised in the following autumn a small number of Isle of Wights were included. This confusion throws some doubt on the actual individual weights, but is insufficient to affect the general result. The total number raised, exclusive of those transferred to a caisse (see Ref. No. 10), was 2,640, of which only 264 had increased sufficiently in fish weight to be classed as marketable. The remainder, 2,376, had developed very little, either in gross or fish weight, but the small number which were put into a caisse did considerably better.

It is to be noted that the locus of the second year's laying was less favourable than that of the first year's, being an artificial parc, exempt for some considerable time at low spring tides from ebb and flow, and perhaps somewhat overcrowded. These Arcachons, however, are not intended to be regarded as oysters for rapid turnover. They are "seed," and in our waters require some years to mature. Though the evidence afforded by our experiments is unfavourable, we are not satisfied that they are wholly unprofitable.

Arcachons. Second Quality (see Tables XII. and XIII.)—9,675, at 9*s.* 6*d.* per 1,000, cost £4 11*s.* 1*d.*, exclusive of carriage. They returned at the end of the first season's laying 19% or 1,819 marketable, value, at 4*s.* per hundred, £3 12*s.* 9*d.* The losses were 52%, and the unmarketable 29% or 2,815 had no value for immediate sale. Individually we cannot trace them during the next year, because, owing to want of space for innumerable small separate layings, it was decided to mix first and second qualities in lots of the same sizes and average weights. In the second year, subject perhaps to disadvantage from overcrowding and to some preventible mortality from sanding, these mixed lots sustained a loss of 49%.

Of Arcachons of the sizes included in the first and second qualities, viz., from 5 to 7 cm., and by our measurement with Auray gauge 2″ to 2½″, weights respectively 24-32 and 29-37 kilo. per thousand, it seems permissible to remark that they are not worth raising at the end of the first season's laying for the few barely marketable oysters that may then be found among them. The latter are not comparable with Irish west coast natives of the same shell size, though quite as satisfactory in flavour. The raisings for observation of growth to which they were subjected certainly did them no good, and may, as we have reason to suspect, from rough handling during measurement and too long exposure out of water, have materially affected their welfare during the second season. They are seed oysters, and whoever shall decide to import them for ground layings would be well advised, we believe, to leave them for two seasons unmolested except for necessary raking and general clearance of the bed from sand and dirt.

We do not here take account of the first consignment of Aurays, because the number found marketable at the end of the first season's laying was insignificant.

The second consignments of Arcachons and Aurays were used, as has been seen, for experiment of growth, etc., in relation to numbers laid in caisses, and consideration of the money aspect of their caisse culture may be postponed until further work has been done on the lines indicated by the results of their number trials.

The tabular statements which follow form the data for the conclusions which we have attempted above as to the value of the varieties of oyster named in them. The statements of condition are of much importance, since a light fat oyster is worth more than a heavy thin one.

NUMBER OF MARKETABLE OYSTERS found on raising the 1st consignments at stocktaking, 1902.

QUALITY.	Net No. laid less Samples, &c.	Total No. Raised Marketable.	Nos. at Sizes. 3″ or over.	2½″.	2″.	Total No. Raised Not Marketable	Sizes. 2½″.	2″.	1½″.	Percentage to Net No. Laid. Marketable.	Not Marketable.	Losses.
Tralee, ...	120,044	45,578	16,502	29,076	—	17,692	—	17,692	—	38%	15%	48%
Clarenbridge, ..	8,114	2,324	448	1,490	386	2,085	251	1,822	12	29%	26%	46%
Isle of Wight, ..	8,955	3,899	2,102	1,797	—	907	303	604	—	44%	10%	46%
Kentish Knock, ..	1,785	195	111	84	—	1,210	283	557	370	11%	68%	21%
Dutch, ...	960	127	4	123	—	529	5	524	—	13%	55%	32%
Arcachon, 1st quality,	11,515	2,714	296	2,418	—	5,133	742	4,391	—	24%	45%	32%
Do. 2nd quality,	9,675	1,819	190	1,629	—	2,815	192	2,623	—	19%	29%	52%

NUMBER OF MARKETABLE OYSTERS found on raising at stocktaking, 1903, the oysters of 1st consignment, which had been relaid.

Tralee, Layings, ..	45,079	19,738	929	13,494	5,315	4,363	—	4,002	361	44%	10%	47%
„ in Caisses, ..	1,800	1,162	139	882	141	38	—	38	—	65%	2%	34%
„ Check Layings	600	222	16	156	50	0	—	—	—	37%	—	63%
Clarenbridge, ..	3,513	869	214	655	—	536	—	536	—	25%	15%	60%
Isle of Wight, ..	3,490	821	422	399	—	58	15	43	—	24%	2%	75%
Arcachons, mixed qualities, with some Isle of Wight and Kentish Knock.	10,725	2,235	184	2,051	—	3,225	—	3,108	117	21%	30%	49%

NUMBER OF MARKETABLE OYSTERS found on raising the 2nd consignments at stocktaking, 1903.

Tralee, in Caisses, ..	4,165	1,919	295	1,361	263	1,365	492	873	—	46%	33%	21%
„ Check Layings,	1,400	665	27	437	201	175	5	170	—	48%	13%	40%
Clarenbridge, in Caisses.	4,500	3,090	612	1,859	619	828	—	828	—	69%	18%	13%
Clarenbridge, Check Layings.	1,200	701	124	437	140	196	21	175	—	58%	16%	25%

CONDITION OF FISH OF MARKETABLE SAMPLES of the 1st consignments, examined at stocktaking of the first year of the experiment.

QUALITY.	No. Examined.	Percentage: V. Thin.	Thin.	Mod.	Fat and very Fat.
Tralee, ...	876	0	4	21	75
Clarenbridge, ...	400	1	7	17	76
Isle of Wight, ...	490	0	13	27	60
Kentish Knock, ...	86	0	7	16	77
Dutch, ...	50	0	0	20	80
Arcachon, 1st quality, ..	100	0	2	20	78
„ 2nd quality, ...	100	0	2	9	89

CONDITION OF FISH OF MARKETABLE SAMPLES of the 1st consignments, examined at stocktaking of the 2nd year of the experiment.

QUALITY.	No. Examined.	Percentage: V. Thin.	Thin.	Mod	Fat and very Fat.
Tralee Layings, ...	672	4	8	33	55
„ Caisses, ...	305	1	8	27	64
„ Check-laying, ...	60	2	5	16	77
Clarenbridge, ...	263	3	11	23	63
Isle of Wight, ...	100	21	23	36	20
Arcachon, 1st and 2nd qualities, ..	204	5	12	34	49

CONDITION OF FISH OF MARKETABLE SAMPLES of 2nd consignments, examined at stocktaking (1903).

QUALITY.	No. Examined.	Percentage: V. Thin.	Thin.	Mod.	Fat and very Fat.
Tralee Caisses, ...	593	2	8	33	58
„ Check layings, ..	265	5	14	48	34
Clarenbridge Caisses, ...	764	5	11	33	51
„ Check Layings, ..	159	11	18	39	31

TABLE
(See

TABLE OYSTERS IMPORTED FROM ENGLAND

Date of Laying.	Quality.	Total Number Laid.	Numbers at Sizes. 3″	2½″	2″	1½″	Date of Raising.	Total Number Raised.
15. 4. 04.	Small Burnhams.	202	–	–	86	116	16. 5. 04.	193
15. 4. 04.	Medium Burnhams.	203	–	5	190	8	16. 5. 04.	195
15. 4. 04.	Finest Whitstables.	204	38	165	1	–	16. 5. 04.	192
15. 4. 04.	Medium Whitstables.	200	4	130	66	–	16. 5. 04.	197
15. 4. 04.	Relaid Brittanys.	204	12	134	58	–	16. 5. 04.	203

SAMPLES OF ABOVE MEASURED AND WEIGHED (GROSS)

Date of Laying.	Quality.	Number Laid.	Size.	Average Gross Weight in Grmes.	Date of Raising.	Number Raised.	Losses,	Average Gross Weight in Grmes.
15. 4 04.	Small Burnhams.	50	2″	39·0	16. 5. 04.	47 *(3)	3 or 6% –	40·0 (40·5)
15. 4. 04.	Medium Burnhams.	50	2″	49·0	16. 5. 04.	48 *(2)	2 or 4% –	51·5 (47·2)
15. 4. 04.	Finest Whitstables.	50	2½″	64·0	16. 5. 04.	48 *(2)	2 or 4% –	68·6 (66·4)
15. 4. 04.	Medium Whitstables.	50	2½″	54·0	16. 5. 04.	50	0 or 0%	55·6
15. 4. 04.	Relaid Brittanys.	50	2½″	63·0	16. 5. 04.	50	0 or 0%	66·6

* Added from oysters of same size etc,

XXX.

page 332.)

AND LAID FOR A MONTH IN ARDFRY POND.

Number Raised with Sizes and Average Weights.								Total Losses.	Number at Sizes.			
3″	Average Gross Weight in Grmes.	2½″	Average Gross Weight in Grmes.	2″	Average Gross Weight in Grmes.	1½″	Average Gross Weight in Grmes		3″	2½″	2″	1½″
-	-	-	-	80	40·2	113	36·5	9	-	-	6	3
-	-	5	55·0	182	48·3	8	41·4	8	-	-	8	-
36	72·2	155	67·0	1	64·0	-	-	12	2	10	-	-
4	54·8	128	55·1	65	49·6	-	-	3	-	2	1	
12	76·3	134	64·8	57	55·3	-	-	1	-	-	1	-

WHEN LAID; WEIGHED (GROSS AND FISH) WHEN RAISED.

Average Fish Weight in Grmes.	Condition.						Increase (+) on average Gross Weight when laid.	Average Weight of Shells of 50 Oysters Examined.	Remarks
	V. Fat.	Fat.	Mod.	Thin.	V. Thin.	Spat.			
6·1	22	20	3	3	2	0	Grmes. { +1·0 - }	29·8	"Shells white and clean inside. Clean and much worn outside. No new growth. Fish small, but plump and fat."
7·6	19	22	9	-	-	0	{ +2·5 - }	38·5	"Same as for 'Small Burnhams,' see above."
10·1	19	23	8	-	-	0	{ +4·6 - }	50·8	"Clean even lot on arrival. New growth just showing. Shells very discoloured inside, and rather fragile. Fish fine and fat."
8·3	13	27	10	-	-	0	+1·6	42·1	"Same as for 'Finest Whitstables,' see above."
7·0	-	22	21	4	3	0	+3·6	52·4	"Shells clean, much worn outside, badly discoloured inside. Fish not so good as in the other qualities."

to bring numbers up to 50.

VIII.—"QUARANTINE."

Table XXX.

This table gives the result of a small experiment designed to ascertain what losses in number and weight of stock might be entailed by holding oysters imported from England for a month on a western bed. It was assumed that a month would be considered by the consumer enough to free the oysters from any suspicion which might attach to the bed of origin. The Royal Commission on Sewage Disposal* recommended a period of six weeks, but as the season was getting late and we wanted the site of the experiment for other purposes, the period was limited as above. As the table shows, the oysters presented no signs of going back, nor did the rate of mortality appear to be increasing at the end of the month, so that the extension of the period to six weeks would probably have made very little difference in the results.

It must be understood that no suspicion whatever attaches to the oysters which we used for experiment. We purchased them as the best table oysters to be had at the time, as for our purpose it was necessary to deal with stock already in the highest condition, and the purveyor, in forwarding them, mentioned that they were raised from layings of certified purity. Probably we could not have obtained polluted oysters, had we wanted them, as merchants of repute would not care to be known to handle them, and bacteriological examination was no part of our experiment.†

The oysters on receipt at Ardfry were put in water for 12 hours or more, then raised, and 50 of the predominant half-inch size in each lot were weighed for gross weight. The whole were then relaid in caisses (the samples of 50 being placed in separate compartments) for a month in a place which cannot, from the examination of other stock kept there, be considered as having had any special advantages as a fattening ground during that period. At the end of the month the oysters were raised, the samples re-weighed for gross weight, opened and weighed for condition and weight of fish, and the shells weighed separately. The rest of the consignment was measured into half-inch sizes and weighed. It will be seen that the samples appear to have gained a little in gross weight, and the fish at the end of the month were in excellent condition.

The weather being warm, some of the consignments showed signs of weakness on arrival, and this probably accounts for most of the lossss, which in no lot reached 6%, the minimum being under 0·5%. Handling, on arrival, was restricted to the selection and weighing of the samples, because, if this had been a business transaction, there would have been no necessity for sorting at all.

For practical purposes the experiment demonstrates the possibility of conveying oysters from the East of England to the West of Ireland, and of holding them there for a month without serious loss in number and with no loss in condition. The financial result depends on the difference between the cost price of oysters delivered and the fancy value they may acquire by having been isolated on a laying which commands the confidence of the public. Even in the case of these oysters, which required no purification, and were therefore marketable already at a fair price, the transaction would have yielded a small net profit.

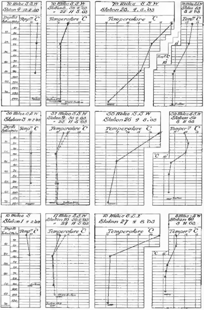
* Fourth Report [Cd. 1883.], 1904.

† Experiment designed to definitely settle the number of days actually requisite for the purification of specifically polluted oysters, and the span of life in sea water of certain disease organisms is in contemplation, and will be prosecuted as soon as possible. It is needless to say that the bacteriological part of the work will be entrusted to a specialist.

Quarterly observations of Temperature expressed in Curves

Fastnet Stations

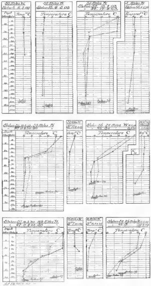
When the observations of two Stations are plotted on the same Section of this Table the dotted Line refers to the Second Station



Quarterly Observations of Temperature expressed in Curves

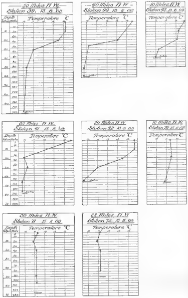
Cleggan Head Stations

When the Observations of two Stations are plotted on the same Section of this Table the dotted line refers to the second Station



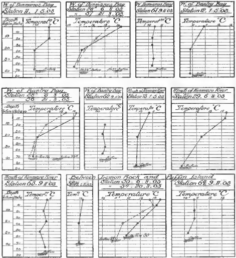
Quarterly observations of Temperature expressed in Curves

Rathlin O'Beirne Stations



Quarterly Observations of Temperature expressed in Curves - Stations Between Mizen Head Co. Cork and Bray Head Co. Kerry -

When the Observations of two Stations are plotted on the same Section of this Table the dotted line refers to the second Station



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Appendix, No. IX.

QUARTERLY OBSERVATIONS OF TEMPERATURE, S.S. *HELGA*.

Tables and Charts.

On the inception of the international scheme of quarterly expeditions for the investigation of the physical conditions obtaining throughout the year in the waters immediately connected with the north-east corner of the Atlantic, it became evident that no such investigation could hope to be complete unless pushed considerably to the south and westward of the principal masses of land enclosing the areas in question, at least as far as the edge of the Atlantic slope.

No provision having been made for this extension by the countries interested, the Department felt that they might with advantage extend the series of temperature observations which they were already collecting in connection with the Irish fisheries, in order to fill, partially at least, this blank. It was accordingly arranged that the Department's steam cruiser *Helga* should, in addition to her ordinary work, make special cruises off the west and south-west coasts in February, May, August, and November. The extent of the area bounded to the westward by the Porcupine Bank renders it impossible to carry these cruises beyond the 1,000-fathom line except to the north-west of Co. Mayo; the practical limit for a vessel such as the *Helga*, on these coasts, has proved to be about seventy miles from land, though under favourable weather conditions this has been sometimes exceeded.

The following tables of temperature observations are merely an excerpt from the mass of those collected, with which it is hoped to deal later in more comprehensive fashion; they are printed for the sake of comparison with the data of the International Council.

The repetition of the observations at each station is specially undertaken with a view to finding how far the influence of intervening atmospheric disturbances upon the physical conditions of the ocean affects the value of isolated observations as representative of the conditions for the time of year.

The Department are much indebted to the enterprise and energy of Mr. Geo. H. T. Beamish, A.M.I.C.E., of Queenstown, for the successful carrying out of the cruises, and for assistance in preparing the results for publication.

QUARTERLY OBSERVATIONS OF TEMPERATURE, SS. "HELGA."

Stations off Fastnet Lighthouse, Co. Cork.

Date.	Position.	Soundings.		Temperature.			Hour.
		Fathoms	Metres	Fathoms.	Metres.	°C.	
12.2.03	70 mi. S.S.W., .. St. 4	76·5	140	0 20 50	0 36·5 91·5	10·7 10·6 10·5	10.40 a.m. to 1.30 p.m.
10.2.03	30 mi. S.S.W., .. St. 3	70	128	0 20 50	0 36·5 91·5	10·1 10·1 10·1	11 a.m.
4.2.03	15 mi. S., .. St. 1	50	92	0 20	0 36·5	9·7 10·0	8 to 10 a.m.
7.2.03	9·5 mi. S.S.W., .. St. 2			0	0	9·9	8 to 8.30 a.m.
30.4.03	70 mi. S.S.W., .. St. 8	78·5	143	0 20 50 78	0 36·5 91·5 142·5	11·0 10·3 10·3 10·3	10.30 a.m.
11.5.03	70 mi. S.S.W., .. St. 22	80	146	0 20 50 79	0 36·5 91·5 144·5	11·0 10·3 10·3 10·3	10.30 a.m.
30.4.03	37 mi. S.S.W., .. St. 9	71	130	0 20 50 70	0 36·5 91·5 128	10·6 9·9 10·1 10·0	6.15 p.m. to 7.10 p.m.
11.5.03	36·5 mi. S.S.W., .. St. 23	69	126	0 20 50 67	0 36·5 91·5 122·5	11·0 9·9 9·9 9·9	6.30 p.m. to 7.15 p.m.
30.4.03	Abt. 17·5 mi. S.S.E., St. 10	69·5	127	0 20 50	0 36·5 91·5	10·3 9·6 9·7	9 to 9.40 p.m.
11.5.03	16·5 mi., S.S.W., .. St. 24	60·5	111	0 20 59	0 36·5 108	10·8 9·6 9·8	9.45 p.m.

QUARTERLY OBSERVATIONS OF TEMPERATURE, SS. "HELGA."

Stations off Fastnet Lighthouse, Co. Cork—*continued.*

Date.	Position.	Soundings.		Temperature.			Hour.
		Fathoms	Metres	Fathoms	Metres.	°C.	
4.8.03	70 mi. S.S.W., .. St. 25	80	146	0 20 47·3 78	0 36·5 86·5 142·5	16·1 14·2 13·2 10·2	11.45 a.m.
4.8.03	35 mi. S.S.W., .. St. 26	70·5	129	0 27·5 68* 70	0 50 124* 128 ·	14·9 11·0 10·3 10·2	8 p.m.
4.8.03	Abt. 15 mi. S.S.E., St. 27	68	124	0 20 66	0 36·5 121	15·0 10·4 10·2	11 to 11.30 p.m.
8.11.03	70 mi. S.S.W., .. St. 58	81	148	0 20 47·5 50 80	0 36·5 87 91·5 146	12·55 12·25 10·9 †10·82 †10·77	9 a.m. to 12 noon
8.11.03	Abt. 30 mi. S.S.W., St. 59	64·5	118	0 10 19·5 29 40 58	0 18 35·5 53 73 106	11·9 12·25 12·0 10·6 †10·47 †10·47	4.15 p.m. to 4.50 p.m.
8.11.03	8 mi. S.W., .. St. 60	58	106	0 10 29 35 40 55	0 18 53 64 73 100·5	11·2 11·2 10·4 10·3 †10·22 †10·22	6.40 p.m.

Stations off Tearaght Lighthouse, Co. Kerry.

Date.	Position.	Fathoms	Metres	Fathoms	Metres.	°C.	Hour.
14.2.03	50 mi. W., .. St. 5	334·5	611	0 20 50 100 100	0 36 5 91·5 183 183	10·6 10·6 10·5 10·7 10·6	4 to 8.20 a.m.

* Approximate depth.
† These readings were taken from the water-bottle thermometer.

QUARTERLY OBSERVATIONS OF TEMPERATURE, SS. "HELGA.

Stations off Tearaght Lighthouse, Co. Kerry—*continued.*

Date.	Position.	Soundings.		Temperature.			Hour.
		Fathoms.	Metres.	Fathoms.	Metres.	°C.	
2.5.03	50 mi. W., St. 15 ..	290	530	0 18 43 100 216	0 33 79 183 395	11·3 10·6 10·4 10·3 10·0	9 a.m. to 12 noon
8.5.03	50 mi. W., St. 19 ..	280	512	0 23 50 100 150	0 42 91·5 183 274	10·9 10·6 10·4 10·15 10·1	9 a.m. to 12 noon
8.5.03	30 mi. W., St. 20 ..	148	270	0 20 50 100	0 36·5 91·5 183	11·0 10·4 10·3 10·3	2.45 p.m. to 3.35 p.m.
8.5.03	13 mi. W., St. 21 ..	74	135	0 20 50 74	0 36·5 91·5 135	11·1 10·15 10·0 10·0	5.50 p.m. to 6.40 p.m.
7.8.03	50 mi. W., St. 31 ..	306	559	0 19 49 93·5 250	0 35 89·5 171 457	15·3 12·6 10·7 10·5 10·3	8 a.m. to 12 noon
19.8.03	50 mi. W., St. 49 ..	325	594	0 18 41·5 73·5 323	0 33 76 134·5 590·5	14·5 14·1 11·0 10·7 9·95	10 a.m. to 12 noon.
19.8.03	40 mi. W., St. 50 ..	170	311	0 18 41·5 77 169	0 33 76 141 308	14·3 14·2 10·9 10·8 10·2	1.30 p.m.
7.8.03	30 mi. W., St. 32 ..	117	214	0 20 50 116	0 36·5 91·5 212	15·2 12·1 10·6 10·5	2.30 p.m.

Quarterly Observations of Temperature, SS. "Helga."

Stations off Tearaght Lighthouse—*continued.*

Date.	Position.	Soundings. Fathoms.	Soundings. Metres.	Temperature. Fathoms	Temperature. Metres.	Temperature. °C.	Hour.
19.8.03	30 mi. W., .. St. 51	102	186	0 16·5 30 44 99	0 30 55 80·5 181	14·3 13·9 10·7 10·6 10·3	3 p.m.
19.8.03	Abt. 18·5 mi. W., St. 52	80	146	0 18·5 26·5 37·5 76	0 34 48·5 68·5 139	14·3 14·1 10·8 10·4 10·1	4.30 p.m.
7.8.03	11·5 mi. W. by N., St. 33	78	143	0 19·5 40 76	0 35·5 73 139	15·3 15·1 10·8 10·3	5 to 5.30 p.m.
19.8.03	8·5 mi. W .. St. 53	76	139	0 18·5 26·2 41·7 69·5	0 34 48 76·5 127	14·6 13·4 11·3 10·3 10·1	5.50 p.m. to 6.15 p.m.
0.11.03	50 mi. W., .. St. 65	348	636	0 9·7 19 44 93 191 285	0 18 35 80·5 170 349 522	11·9 11·7 11·95 11·7 11·7 *10·39 *10·17	3 to 4 p.m.
10.11.03	30 mi. W., .. St. 66	104	190	0 10 19 29 49 98	0 18 35 53 89·5 179	11·6 11·15 11·3 11·3 *11·37 *10·42	7.15 to 8 p.m.
10.11.03	7 mi. W., .. St. 67	76	139	0 10 20 30 50 75	0 18 36·5 55 91·5 137	11·0 10·9 10·8 10·8 *10·42 *10·42	9.50 p.m. to 10.30 p.m.

* These readings were taken from the water-bottle thermometer.

QUARTERLY OBSERVATIONS OF TEMPERATURE, SS. "HELGA."

Stations off Cleggan Head, Co. Galway.

Date.	Position.	Soundings.		Temperature.			Hour.
		Fathoms.	Metres.	Fathoms.	Metres.	°C.	
16.2.03	50 mi. W. St. 6	113	207	0	0	10·2	11.20 a.m. to 1 p.m.
				20	36·5	10·1	
				50	91·5	10·2	
20.2.03	10 mi. W.. St. 7	49	89·5	0	0	8·9	9.30 a.m. to 10.10 a.m.
				17	31	8·9	
				24	44	9·5	
4.5.03	50 mi. W., St. 16	120	219	0	0	10·1	11.10 a.m. to 12.5 p.m.
				21	38·5	9.9	
				53·5	98	9·9	
				105	192	9·8	
4.5.03	30 mi. W, St. 17	72	132	0	0	10	4.30 p.m.
				20	36·5	9·4	
				50	91·5	9.3	
				70	128	9·3	
4.5.03	10 mi. W., St. 18	58	106	0	0	10·1	6.0 p.m.
				20	36·5	9·3	
				50	91·5	9·1	
10.8.03	50 mi. W., St. 34	114·5	208	0	0	14·2	11.35 a.m. to 1.20 p.m.
				19	35	14·0	
				25·5	46·5	10·6	
				43	78·5	10·4	
				106	194	10·1	
17.8 03	50 mi. W., St. 44	116·5	213	0	0	14·1	10.40 a.m. to 1.20 p.m.
				19·5	35·5	10·5	
				29·2	53·5	10·5	
				49·5	90	9·8	
				115	210	10·15	
10.8.03	38 mi. W., St. 35	75	137	0	0	14·7	3.30 p.m.
				19·5	36	12·8	
				29	53	10·2	
				49	89·5	10·2	
				73	133·5	9·9	
17.8.03	40 mi. W., St. 45	93·5	171	0	0	14·1	2.50 p.m. to 3.10 p.m.
				19·5	35·5	13·5	
				29	53	10·6	
				48·2	88	10·8	
				92·5	169	10·0	

QUARTERLY OBSERVATIONS OF TEMPERATURE, SS. "HELGA."

Stations off Cleggan Head, Co. Galway—*continued.*

Date.	Position.	Soundings.		Temperature.			Hour.
		Fathoms.	Metres.	Fathoms	Metres.	°C.	
10.8.03	28 mi. W., .. St. 36	63	115	0 19·7 34 48·5 61	0 36 62 88·5 111·5	15 12·35 10·0 9·6 9·65	5.0 p.m.
17.8.03	30 mi. W., .. St. 46	82	150	0 19·5 29 47 81	0 35·5 53 86 148	14·4 11·4 10·4 10·5 9·8	4 to 4.25 p.m.
10.8.03	18.5 mi. W., .. St. 37	62	113	0 20 30 50 61	0 36·5 55 91·5 111·5	14·9 14·8 12·3 9·9 9·9	6.30 p.m.
17.8.03	20 mi. W., .. St. 47	59·5	109	0 19·5 28 37·5 58·5	0 35·5 51 68·5 107	14·9 13·3 13·1 10·8 9·8	5.30 p.m.
10.8.03	8½ mi. W., .. St. 38	54	99	0 19·5 27 38 51	0 35·5 49·5 69·5 93	15·0 14·3 13·5 11·9 11·3	7.30 p.m.
17.8.03	*10 mi. W., .. St. 48	57	104	0 19·5 27·7 38·5 55	0 35·5 50·5 70 100·5	14·2 13·8 12·75 11·6 10·3	6.40 p.m. to 7.5 p.m.
11.11.03	50 mi. W., .. St. 68	126	230	0 9·5 17·5 19 26 47 116	0 17·5 32 35 47·5 86 212	11·25 11·15 11·3 †11·52 11·2 †11·17 †10·37	11.30 a.m. to 1.30 p.m.
11.11.03	30 mi. W., .. St. 69	78	143	0 8·7 14·5 23·5 46 63·5	0 16 26·5 43 84 116	11·35 10·1 11·4 11·3 †11·22 †10·22	3.40 p.m.

* Drifted N. of Position.
† These readings were taken from the water-bottle thermometer.

QUARTERLY OBSERVATIONS OF TEMPERATURE, SS. "HELGA."

Stations off Rathlin O'Beirne Lighthouse, Co. Donegal.

Date.	Position.	Soundings.		Temperature.			Hour.
		Fathoms.	Metres.	Fathoms.	Metres	°C.	
13.8.03	50 mi. N.W., St. 39 ..	97·5	178	0 10 19·5 29·2 49·2 96·5	0 18 36 53·5 90 176·5	14·2 14·2 13·5 11·0 10·3 10·0	1 to 2.30 p.m.
13.8.03	40 mi. N.W., St. 40 ..	59	108	0 20 25 50 58	0 36·5 46 91.5 106	14·6 13·1 10·2 9·7 9·7	3.30 to 4 p.m.
13.8.03	30 mi. N.W., St. 41 ..	57·5	105	0 17·7 28·7 45·2 56	0 32·5 52·5 83 102·5	14·6 10·0 10·3 9·8 9·8	5 to 5.20 p.m.
13.8.03	20 mi. N.W., St. 42 ..	46	84	0 10 19·7 29·5 44·5	0 18 36 54 81·5	14·7 14·7 13·5 11·0 9·6	6.20 p.m.
13.8.03	10 mi. N.W., St. 43 ..	40	73	0 10 20 30 38	0 18·5 36·5 55 69·5	14·9 14·3 14·1 12·3 12·0	7.30 p.m. to 7.50 p.m.
15.11.03	30 mi. N.W., St. 71 ..	67·5	124	0 9·7 20 28·5 48·5 57	0 18 36·5 52 89 104·5	11·3 10·9 *11·2 11·2 *11·17 *11·22	11.0 a.m. to 12 noon
15.11.03	22 mi. N.W., St. 72 ..	50	91	0 9·7 20 43·5	0 18 36·5 79·5	11·2 10·9 *11·22 *11·22	1 to 1.30 p.m.
15.11.03	10 mi. N.W., St. 70 ..	47·5	87	0 18·5 20 46·5	0 33·5 36·5 85	11·4 11·5 *11·47 *10·87	7.30 a.m. to 8.20 a.m.

* These readings were taken from the water-bottle thermometer.

Quarterly Observations of Temperature, SS. "Helga."

Stations between Mizzen Head and Dursey Head, Co. Cork.

Date.	Position.	Soundings. Fathoms.	Soundings. Metres.	Temperature. Fathoms	Temperature. Metres.	Temperature. °C.	Hour.
1.5.03	W. of Dunmanus Bay St. 11	38	69·5	0 10 20 37	0 18 36·5 67·5	11·1 11·1 9·9 9·9	11.40 a.m. to 12.5 p.m.
6.8.03	W. of Dunmanus Bay, St. 28A.	39·5	72	0 20 35	0 36·5 64	14·3 11·2 10·6	9 to 9.20 a.m.
21.8.03	W. of Dunmanus Bay St. 57	38	69·5	0 10 20 30 36	0 18·5 36·5 55 66	13·4 12·35 11·4 10·9 10·8	8.10 p.m. to 8.30 p.m.
9.11.03	W. of Dunmanus Bay, St. 61	37·5	69	0 9.5 15·5 27·5 34	0 17·5 28·5 50·5 62	10·5 10·3 10·3 10·4 *10·32	11.15 p.m.
1.5.03	W. of Bantry Bay, St. 12	42	77	0 20 41	0 36·5 75	10·9 9·8 9·8	12.50 p.m. to 1.10 p.m.
6.8.03	W. of Bantry Bay, St. 28B.	39	71	0 5 20 37	0 9 36·5 67·5	14·2 14·0 11·1 10·8	
21.8.03	W. of Bantry Bay, St. 56	38·5	70	0 10 24·5 29·5 37	0 18·5 45 54 67·5	13·4 11·8 10·9 10·8 10·5	7.10 p.m. to 7.30 p.m.
9.11.03	W. of Bantry Bay, St. 62	39·5	72	— 9·7 17·5 29 35	— 18 32 53 64	— 10·6 10·4 10·6 *10·4	12.30 p.m.

Stations between Dursey Head and Bray Head, Co. Kerry.

Date.	Position.	Soundings. Fathoms.	Soundings. Metres.	Temperature. Fathoms	Temperature. Metres.	Temperature. °C.	Hour.
1.5.03	Mouth of Kenmare River. St. 13	45	82	0 20 45	0 36·5 82	10·7 9·8 9·7	2 to 2.30 p.m.

* These readings were taken from the water-bottle thermometer.

QUARTERLY OBSERVATIONS OF TEMPERATURE, SS. "HELGA."

Stations between Dursey Head and Bray Head, Co. Kerry—*continued.*

Date.	Position.	Soundings.		Temperature.			Hour.
		Fathoms.	Metres.	Fathoms.	Metres.	°C.	
6.8.03	Mouth of Kenmare River. St. 29	47	86	0 5 20 46	0 9 36·5 84	14·4 14·3 12·4 10·8	2.0 p.m.
9.11.03	Mouth of Kenmare River. St. 63	46	84	0 9·5 18·5 28 41	0 17·5 34 51 75	10·85 10·6 10·8 10·3 *10·72	2.30 p.m.
1.5.03	Between Puffin Id. and Lemon Rock. St. 14.	37·5	68·5	0 20 37	0 36·5 67·5	10·2 9·9 9·9	3.30 p.m. to 3.50 p.m.
6.8.03	Between Puffin Id. and Lemon Rock. St. 30.	32·5	59	0 5 20 31	0 9 36·5 56·5	14·6 14·3 12·8 11·9	3.45 p.m. to 4.5 p.m.
20.8.03	Between Puffin Id. and Lemon Rock. St. 54	35	64	0 5 10 20 33	0 9 18·5 36·5 60·5	13·8 14·0 13·2 11·6 11·1	3.30 to 4 p.m.
9.11.03	Between Puffin Id. and Lemon Rock. St. 64	35	64	0 9·5 16·5 29	0 17·5 30 53	10·8 10·8 10·85 10·3	4.0 p.m.
	Miscellaneous Stations.						
16.11.03	4·5 mi. W.N.W. of Bloody Foreland. St. 73	30·5	56	0 9·5 23	0 17·5 42	10·9 11·1 10·65	3.20 p.m. to 3.50 p.m.
18.11.03	E. of Tor Pt. (Co. Antrim). St. 74	76	139	0 10 20 50 70	0 18·5 36·5 91.5 128	11·4 11·35 *11·42 *11·42 *11·42	7.5 p.m. to 7.50 p.m.
18.11.03	E. of Garron Pt. (Co. Antrim). St. 75.	69·5	127	0 20 40 65	0 36·5 73 119	11·4 *11·47 *11·47 *11·47	8.30 to 9 a.m.

* These readings were taken from the water-bottle thermometer.

QUARTERLY OBSERVATIONS OF TEMPERATURE, SS "HELGA."

For purposes of comparison, the following observations taken on SS. "Helga" in 1901 and 1902 are here annexed.

Those in 1901, having been taken with much smaller instruments, cannot be considered accurate to the same degree as the rest.

Stations off Cleggan Head, Co. Galway.

Date.	Position.	Soundings.		Temperature.			Hour.
		Fathoms.	Metres.	Fathoms.	Metres.	°C.	
4.7.01	30 mi. W., St. 82	72	131·5	0 70	0 128·1	15·1 9·4	11.15 a.m.
Do.,	20 mi. W., St. 83	67	122·5	0 60	0 109·7	15·1 9·4	1.0 p.m.
Do..	10 mi. W., St. 84	60	109·7	0 60	0 109·7	15·1 10·1	2.30 p.m.
8.7.01	40 mi. W., St. 88	78	142·7	0 abt. 76	0 139	15·9 9·1	11.40 a.m.
15.7.01	10 mi. W., St. 96	60·5	110·7	0 55	0 100·5	14·7 10·0	3.55 p.m.
31.7.01	10 mi. W., St. 106	56	102·5	0 55	0 100·5	13·9 9·4	10.35 a.m.
11.9.01	40 mi. W., St. 129	76·5	140	0 70	0 128·1	14·7 9·5	1.35 p.m.
Do.,	30 mi. W., St. 128	62·5	114·4	0 60	0 109·7	14·5 9·2	11.40 a.m.
12.9.01	50 mi. W.,	110	201·1	0 105	0 192·2	14·5 10·0	12.30 p.m.
Do.,	20 mi. W.,	69	126	65	119	9·5	
14.8.02	20 mi. W., St. A I.	72·5	132·7	0 72·5	0 132·7	15·4 9·6	3.30 p.m. to 3.50 p.m.
15.8.02	50 mi. W., St. A II.	116	212·3	0 116	0 212	14·8 10·0	12.10 p.m. to 12.35 p.m.
16.8.02	10 mi. W., St. A III.	55	100·5	0 55	0 100·5	14·7 9·6	9.50 a.m. to 10.10 a.m.
18.8.02	40 mi. W., St. A IV.	95	173·7	0 95	0 173·9	15·4 9·8	11.55 p.m. to 12.15 p.m.
18.8.02	30 mi. W., St. A V.	72·5	132·7	0 72·5	0 132·7	15·8 9·4	1.45 p.m. to 2.5 p.m.

APPENDIX No. X.

NOTE ON THE MANURIAL VALUE OF THE SEAWEED *CLADOPHORA RUPESTRIS.*

BY

E. W. L. HOLT.

This weed, which forms dark olive-green moss-like clusters a few inches in height, grows in great profusion in Fahy Bay, Ballynakill Harbour, Co. Galway. The bay is almost land-locked at extreme low tides by the bar across its mouth, and the central part is of a depth of one to two fathoms at low-water, the bottom consisting of very soft muddy sand. Over this the weed forms an almost continuous carpet for considerable areas. The bottom is only disturbed by gales from the S.E., and on such occasions, both in winter and summer, the weed is sometimes thrown up on the N.W. corner of the beach in very large quantities.

The common brown seaweed, *Fucus serratus* (and probably other species) is, as everywhere on the coast, cultivated and cropped for manure; and, though less prized than the cut weed, drift *Fucus* is also used as a fertiliser. No use, however, appeared to be made of the *Cladophora*, which is probably common enough in many similar situations in the West.

It occurred to me that it might have some value, and I accordingly placed a sample in the hands of Mr. R. J. Moss, for analysis. His report is given below *in extenso.*

I may add that the weed is easily collected in quantity in a dredge or net, and appears to be abundant at all times of the year.

"Royal Dublin Society,
Kildare Street,
May 12*th*, 1903.

Analysis of Seaweed, received April 3rd.

"In the following results the column headed 'Original' gives the composition of the seaweed in the moist condition in which it was originally received. The seaweed dried in the air at a moderate temperature gave the results in the column headed 'Air-dried,' while in the column headed 'Washed and Air-dried' will be found the analysis of the weed free from the saline matter of sea water. For the purpose of facilitating a comparison with a well-known fertiliser, I have added the composition of rotted farmyard manure according to Voelcker.

100 parts of the seaweed contain:—

—	Original.	Air-dried.	Washed and Air-dried.	Farm-yard Manure.
Moisture,	76·92	12·70	10·41	75·00
*Organic Matter,	17·05	64·48	76·02	18·09
†Ash,	6·03	22·82	13·57	6·91
*Containing Nitrogen,	0·76	2·88	3·19	0·61
†Containing Potash,	0·36	1·38	1·23	0·49
„ Phosphoric Acid,	0·07	0·26	0·25	0·45

Ann. Rep. Fish., Ireland, 1902-03, *Pt. II., App., X.* [1905].

These results show that the seaweed in its original moist condition contains more nitrogen than farmyard manure, and nearly as much potash. It is deficient in phosphoric acid, and, therefore, should be used in conjunction with a phosphatic fertiliser, such as superphosphate of lime.

It is noteworthy that washing, in the fresh condition, has little effect on the constituents of manurial value. The removal of a certain proportion of the salts of sea water necessarily increases the relative quantity of organic matter, and thus raises the percentage of nitrogen. Very little potash appears to be removed by washing, and no phosphoric acid.

The seaweed, whether washed or unwashed, is easily crushed, after drying, to a fine powder, and if it could be obtained in quantity it would probably find a market as a nitrogenous fertiliser. It is about as rich in nitrogen as commercial bone. The nitrogen present in the air-dried samples is equivalent to 3·49 per cent. of ammonia, and, at 10*s.* per unit, this may be valued = £1 14*s.* 10*d.*, the potash and phosphoric acid are value for about 5*s.* per ton—total, £1 19*s.* 10*d.* per ton.

If it is proposed to use the seaweed locally as a manure, I recommend that it should, if possible, be spread out to dry before carting it to the fields. This will reduce the cost of cartage to about one-half, without detracting from the value of the seaweed as a fertiliser.

(Signed), RICHARD J. MOSS, F.C.S., F.I.C.,
Chemical Analyst."

APPENDIX, No. XI.

i.—Report on the Artificial Propagation of Salmonidae for the Seasons of 1902-1903 and 1903-1904, by E. W. L. HOLT.

ii.—Preliminary Note on the Size of Salmon Eggs, in Relation to Estimating their Number, by C. GREEN, B.A.

iii.—Report on the Salmon Hatchery at Lismore, by CHARLES DEANE OLIVER, B.A.I., M.I.C.E.

i.—REPORT ON THE ARTIFICIAL PROPAGATION OF SALMONIDAE FOR THE SEASONS OF 1902-1903 AND 1903-1904.

BY

E. W. L. HOLT.

I estimate the number of fry of salmon and white trout turned down dnring the two last seasons at the figures shown in the subjoined table. The number of brown trout mentioned only includes the output of which we have received reports. Imports of ova and fry of trout and small hatchings of native fish are carried on to a considerable extent, but do not as a rule come under onr notice.

The subsidies paid in the two seasons amounted to £376 12*s.* 3*d.* and £278 11*s.* 9*d.*

It will be seen that in regard to salmon both seasons show an advance over that of 1901-1902, of which I estimated the output at 3,333,500.

It is due to the proprietors of the important hatcheries at Kilrea and Newtownstewart to mention that they consider that my estimate of the number of fry turned out in 1902-1903 is considerably below the mark. I may quite probably have made somewhat too low an estimate, because on the occasion of my inspection the ova were very unevenly distributed in the trays. Unless the trays in a hatchery are at least capable of grouping into series of approximately eqnal contents, it is not possible, in the time that can reasonably be devoted to the purpose and without disturbance of nearly every tray in the hatchery, to arrive at an absolutely correct count.

To some extent we are able to check our estimate made at the eyed stage by returns furnished by managers of hatcheries of the number of pints or fluid ounces of ova stripped from the spawners, and of the number of dead ova removed from day to day. There is, however, in the factor of conversion from measure to number a considerable variation due to size of ova,* while the measurements taken in the hurry of stripping sometimes reach us in such round figures that they are obviously negligible. In the case in point these returns seemed to dispose of the possibility of any considerable error in the figures for which the two hatcheries have been credited in the table.

* See Mr. C. Green's report, p. 350.

Hatchery.	All Salmon.		Foreign Salmon.		White Trout.		Brown Trout.		Remarks.
	1902-3.	1903-4.	1902 3.	1903-4.	1902-3.	1903-4.	1902 3.	1903-4	
Lough Dan, .	-	-	-	-	-	-	-	10,000	"Loch Levens," from Scotland.
Newtownbarry, R. Slaney.	142,000	100,000	-	-	-	-	-	-	
Inistioge, R. Nore,	92,000*	238,000*	-	-	-	-	-	-	
Lismore, R. Blackwater.	1,370,000*	800,000*	-	-	-	-	-	-	
Ballincollig, Cork,	-	-	-	-	-	-	4,000	-	"Loch Levens," from Inishannon
Inishannon, Bandon R.	40,000	-	-	-	-	-	-	-	
Skibbereen, R. Ilen.	70,000	73,600	70,000	73,600	-	-	-	-	
R. Blackwater, Co. Kerry.	80,000	70,000	-	-	-	-	-	-	
Waterville, .	66,000	-	-	-	24,000	-	-	-	
Caragh Lake, .	-	-	-	-	-	-	30,000	60,000	"Loch Levens," from Scotland.
Killorglin, R. Laune	345,000*	183,000*	-	-	-	-	-	-	
Killarney, R. Laune.	-	50,000*	-	-	-	-	-	-	
Muckross, R. Laune.	-	75,000*	-	-	-	-	-	-	
Adare, R. Maigue,	-	-	-	-	-	-	200,000	228,500	Incl. 50.000, and 35,000 from Germany.
Costello, Co. Galway.	-	-	-	-	300,000	270,000	-	-	
Screebe, Co. Galway.	382,000*	356,000*	-	-	80,000	70,000	-	-	
Inver, Co. Galway.	150,000	-	-	-	210,000	-	-	-	
Kylemore, Co. Galway.	-	60,000	-	-	-	2,500	-	-	
Ballysodare, Co. Sligo.	100,000	130,000	25,000	30,000	-	-	-	-	
Kilronan Castle,	-	-	-	-	-	-	-	6,000	
Laroen, R. Drowes.	50,000	-	-	-	-	-	-	-	
Belleek, R Erne,	265,000*	508,000*	-	-	-	-	-	-	
Glenties, R. Owenea.	162,000	220,000	-	-	-	-	-	-	
Dunglow, Co. Donegal.	-	-	-	-	50,000	-	-	-	
Glenveagh, R. Owencarrow.	140,000	188,000	-	-	-	-	-	-	
Newtownstewart, R. Foyle.	550,000*	240,000*	-	-	-	-	-	-	
Kilrea, R. Bann,	629,000*	395,000*	-	-	-	-	-	-	
Lough Neagh, .	-	-	-	-	-	-	-	60,000	Hatched at Kilrea.
Blackcastle, R. Boyne.	1,106,000*	382,000*	-	-	-	-	-	-	
Totals, . .	5,739,000	4,068,600	95,000	103,600	884,000	342,500	234,000	364,500	

* Estimated by officers of the Department.

The hatching season of 1902-1903 was on the whole moderately favourable to artificial propagation, in that, in general, height of water offered no serious obstacle to the capture of spawners. It was, I think, in comparison with the previous decade, distinctly favourable to natural propagation, as a fair volume of water seems to have been generally maintained throughout the critical period.†

The large increase of hatchery output over the preceding year is due to the resumption of work at Lismore. The new hatchery there, which is fully described by Mr. Oliver at p. 352 of this Appendix, heads the list of

† See also Replies received from Clerks of Conservators, Appendix, XII, p 363.

1902-1903 with 1,370,000 fry. Blackcastle, with 1,206,000, is not far behind, and it may be remarked that this establishment, save for a small sum provided by the Department for holding ponds, is entirely due to the enterprise of Mr. FitzHerbert.

The hatchery at Kylemore was idle, owing to the absence of the proprietor. At Killarney and Muckross no spawners could be obtained. At these, as at a number of the smaller hatcheries, there is no efficient means of trapping, and their working is consequently irregular.

In 1903-1904 conditions were decidedly unfavourable to artificial propagation, as high water was pretty general at the time when spawners were required. Blackcastle, which depends upon a crib at the end of a low mill-weir, suffered especially. At Lismore, where the trapping apparatus comes reasonably near perfection, an unusual condition of the river upset our calculations. Commonly, at least of late years, the upper tributaries flood late, and until they flood a great number of fish remain at or below Lismore. In this season the up-country floods came so early that most of the fish went past the weir before trapping operations had commenced. It would have been possible to make up the required number of spawners by fishing the weir until January, but objection was raised on the part of persons interested in angling above the weir that late fishing might interfere with the run of winter clean fish. It was accordingly decided to ask Mr. Penrose, during the season in question, not to take spawners later than the 20th December, though the risk to clean fish seemed remote. I may mention here that in the preceding season clean fish which entered the trap in November and December were marked with silver labels (see Report for 1901, Pt. II., Appendix, No. XIII., p. 187), with results which immensely added to knowledge of salmon movements, and promised most favourably for the solution of one of the most difficult problems in the life-history. Absolutely no evidence could be adduced to show that this practice interfered with the sport of anglers; on the contrary, some of the marked fish were recaptured by them. Yet so much outcry was raised that marking was reluctantly abandoned.

The output at Newtownstewart was reduced by very heavy mortality *in ovo*, locally ascribed to an epidemic of unknown nature. News of this only reached us late in the hatching season, and in a sample sent for examination the cause of failure was obviously want of fertilisation. The same cause may or may not have been equally operative in the earlier clutches, and may probably have been due to some unfavourable condition of the water used when the fish were stripped, which could not be ascertained after the event. The experience of the Newtownstewart employés precludes the possibility of any general mismanagement by using unripe spawn or milt.

At Killorglin the output suffered from an accident to the holding pond, whereby a number of spawners escaped. Work at Waterville was suspended from want of funds to provide for the local contribution towards maintenance. At Bundrowes Mr. Singleton discontinued hatching, for reasons which did not include dissatisfaction with the results of his previous enterprise in this matter.

Mr. Haynes' trout hatchery at Ballincollig, started the previous season, was put out of action by poachers, this being the only instance of which I know in which poachers have interfered with hatching apparatus, though they often take a natural interest in spawners impounded in holding ponds.

The resources of Innishannon appear to have been solely devoted to rainbows and American charr, as, in part, during the preceding season. In both seasons we have reports of the propagation of rainbows from several hatcheries, but they do not appear in the table. I have found no reason to change the opinion which I have often expressed that the introduction of rainbows into open waters or into imperfectly grated ponds from which they can (and always do) escape, is at once a danger to our more valuable salmon and white trout, and a waste of money.

Perhaps because those who have tried have, on the disappearance of their fish, convinced themselves and their friends that at least the latter

part of this opinion has a basis of fact, the indiscriminate introduction of rainbows appears to have greatly diminished in this country. Their reasonable utility appears to me to be confined to farming for the market in enclosed ponds, and to affording a mild form of sport in ornamental waters, whence they can by no manner of means reach a salmon river or the sea.

Though unfavourable to artificial propagation of salmon, the season of 1903-1904 was probably exceptionally favourable to natural spawning and to the preservation of ova, fry, and parents, since the height of water appears to have been generally maintained well into the spring. No doubt this applies much more to rivers and streams running through fairly level country than to the mountain torrents which so many fish select for breeding purposes, or to which they are more probably led, without conscious selection, by adventitious circumstances of water supply. Such streams can by no conceivable rainfall be rendered safe nurseries, and an instance of their danger, which came under notice at Lismore (in 1902-1903), is perhaps worthy of mention.

The hatchery derives its water from an intake on the Owenshad, a small glen river with long stretches of excellent spawning gravel in its lower reaches, but liable to sudden and violent floods. A number of fish took this river as usual, and after spawning time there came a flood. The hatchery supply was unaccountably cut off, and on inspection it was found that this was due to the screens being choked by dead ova from the Owenshad. The number of ova which were carried into the hatchery shoot, a wooden trough 11 by 9 inches and controlled as to intake by sluices, must have been infinitesimal compared with what went down the main stream and the holding-pond channel. Though I should be sorry to associate myself with any estimate that has been made of the *average* mortality of naturally deposited ova, since all such estimates are the merest guess-work, it is evident that in this instance the exertions of the parents can have yielded no great result in progeny; and that such occurrences are by no means infrequent can be gleaned from the most casual observation of the gravel banks of any mountain stream.

The Department's subsidies to hatcheries are in all cases *pro rata* to output, and when the circumstances of rainfall compensate for failure of artificial propagation by material improvement of the conditions affecting the natural nurseries, this is matter for congratulation to the general public rather than to the proprietor of a hatchery, who has about as much, sometimes more, trouble, and gets less pecuniary return. It will be possible in the future to take such circumstances into account when determining the annual subsidies, but, as it is perhaps unnecessary to observe, our powers in this respect will be exercised with the most rigid circumspection.

Speaking generally of the two seasons' work, I am glad to be able to report that the care bestowed on the selection of sites for planting fry, and on their handling during transport, shows constant improvement, and I think it very seldom happens now that the care and expense of hatching is neutralised by neglect in these matters. There is, perhaps, still room for greater care in turning down the fry at the right period of growth, *i.e.*, at or just before the final absorption of the yolk. All available evidence seems to show that even a brief period of starvation (and, except in the hands of persons thoroughly skilled in feeding, detention beyond the yolk-bearing stage is no less) gives a check to the growth of the fry from which it may never recover.

Since the issue of my last report no new salmon hatchery, except that of Lismore, has been established. Negotiations are in progress for the erection of new hatcheries at Carlow on the Barrow and at Killarney on the Lanne, and work may be expected to commence there in the season of 1904-1905.

The Caragh Lake hatchery, which, as dealing solely with non-migratory fish and situate in a Congested District, cannot be subsidised by this Department, has been so far improved that we have been able to recommend it to the Congested Districts Board as worthy of a subsidy, which it has received.

The enlargement of Mr. Hall Dare's hatchery at Newtownbarry on the Slaney, to which I referred in my last report, has proved more difficult than was anticipated. To enlarge a hatchery is easy enough. To provide it with ova is quite a different matter, and the Department does not assent to the expenditure of public money on hatching boxes without reasonable certainty that they will be filled.

The Slaney, like other rivers of Leinster, is of considerable volume and slight gradient, and presents, neither in itself nor in its tributaries, any obvious strategic point for the capture of spawners. Such rivers must, nevertheless, be brought under contribution for hatchery purposes, and the problem is to devise a trap for stock fish, since fortuitous captures by rod and line or by draft net are not sufficiently reliable. Our action has accordingly been confined to trapping experiments, which are not yet complete. Should they result in success no river is likely to prove beyond our powers of exploitation for hatchery purposes.

The Department has approved of a small expenditure at Lough Dan for hatchery purposes of a nature foreign to the usual scheme of increasing the head of fish—trout in this instance. Lough Dan, in Co. Wicklow, is a fishery on which no private rights are claimed or exercised, and to which resort the sportsmen of Dublin, no doubt to the material benefit of the district. Lough Dan discharges ultimately into the Ovoca, and by reason of the poisoning of that river is entirely closed to external influences. For whatever reason, its trout appear to have greatly deteriorated, possibly because the invention of the safety bicycle has within comparatively recent years thrown a greater drain on its resources. The number of fish which rise to the fly seems much the same as ever, but the proportion which are worth a place in the basket is said to have sadly diminished. The local angling society, who have absolutely no separate interest in the fishery and spend the funds which themselves contribute for the public good, conceived that the recent condition of the fishery might be improved by the introduction of new blood and, having erected a small hatchery, imported ova and fry of the kind which is known commercially as "Loch Leven." Subsequently they appealed to the Department for assistance in this emprise. Since it appeared, in view of the isolation of the tributary for the reason noted above, that fresh blood might possibly effect an improvement, while the demand for assistance was most modest in figure, I thought it advisable to recommend a contribution, with the aid of which Mr. R. Archer, the secretary of the society, has constructed an excellent series of ponds.

In these ponds will be reared "Loch Levens," of which the majority will be enlarged, while some are retained for crossing when mature with the native stock and with trout from the adjoining Vartry system as well as the off-spring of Vartry crossed with Lough Dan trout. Other good Irish races of trout will also, by the courtesy of proprietors in various parts of the country, be brought under contribution, and in general the management of the hatchery will seek to attain the retention of a stock of breeding fish from all valuable sources sufficient to maintain the maximum possible crossing.

In the case of nearly all rivers the migratory habits of white trout, which are specifically indistinguishable from brown trout, and which do not, to any knowledge which we possess of their proceedings, disdain union therewith, may probably be relied on to provide sufficient interchange of blood. In this instance such interchange is precluded by impossibility of approach, and the results of our experiment, which Mr. Archer is in a position to note most fully, may serve, at a very small charge on the public funds, to determine an hitherto vexed question.

II.—PRELIMINARY NOTE ON THE SIZE OF SALMON EGGS IN RELATION TO ESTIMATING THEIR NUMBER.

BY

C. GREEN, B.A.

In carrying out the Department's schemes of assistance to the artificial propagation of salmonidae, it has been necessary to estimate annually the number of fry turned down from several hatcheries. To obtain any comprehensive view of creatures so ashamed of their nakedness as alevins being obviously impossible, especially in boxes filled with gravel or stocked originally with unequal numbers of eggs, it has been the practice to base the estimates on the number of eyed eggs in the hatchery, within as short a time as possible of the period at which they are expected to hatch. At this stage the eggs of salmonidae will stand a considerable amount of handling without suffering any damage.

The method employed has been to take an average unit of the space occupied by the eggs in the hatchery, as large as may be practicable, to measure the volume of the eggs contained therein, and to find their number by counting a sample of given volume. This leads to an approximate estimate of the total number in the hatchery, and the present examination of the available records has been undertaken with a view to discovering the bearing of the evident variation in the size of the eggs upon the accuracy of such an approximation.

The measures of capacity used have varied from half a pint to a quart, constructed either of tin, with the bottom perforated, entirely of perforated zinc, or of glass. Comparative experiments with the different measures have not been possible in any number. From a consideration of the shape of the eggs it is evident that they will pack more economically the larger the vessel, and in fact a quart measure, when well shaken down, holds slightly more than the contents of two pints. In the perforated measures the water was allowed to run off; in the glass measure the eggs, being water-borne, did not pack so closely, and it was found that the contents of a perforated zinc pint measure were equivalent to 1·1 pint in the glass.

The results of all the counts of eyed eggs up to the present are as follows:—

Eggs per Half-pint,	11–12	12–13	13–14	14–15	15–16	16–17	17–18	18–19	19–20 Hundred.
No. of Observations,	2	3	3	0	4	2	5	2	1

These are all for perforated zinc measures, *i.e.*, with the water run off the eggs; in the one or two instances in which glass measures have been used, 10 per cent. has been added.

The maximum observed is 1,916, and the minimum 1,129. The average of all observations is 1,540; but the group of numbers from 1,500 to 1,800 clearly includes the great majority of ordinary eggs.

In the *U. S. Fish Commission Bulletin* for 1888, p. 217, W. F. Page gives a count of Atlantic salmon eggs at 4,272 in the standard U.S.A. quart. This is equivalent to 1,287 in half a pint English.

From the above figures we may calculate the diameters of the eggs,* which work out as follows:—

Eggs per Half-pint, ...	1,129	1,500	1,800	1,916
Diameter, Inch, ...	·28	·25	·23	·23

The figures for the diameter are, however, certainly excessive, as the eggs are never packed so closely in the measure as is theoretically possible.

An alternative method of estimation was attempted at Lismore during the past season, namely, by measuring approximately the actual area occupied by eggs, and finding the number in a unit of area. When checked, however, by the weights of the parent fish and the number of pints of eggs laid down, the result was found to be unsatisfactory.

In this connection three observations were made of the number of eggs which lay on a square inch, when packed as closely as possible without compression. Eggs of three obviously different sizes were taken, and the number per square inch calculated from 20 sq. in. and upwards, with the following result:—

—	Large Eggs.	Medium.	Small.
Number per Square Inch,	21·0	25·2	26·9
Diameter, Inch,* ...	·234	·213	·207

* Calculated.

This method probably gives quite accurate figures for the average diameter of the eggs.

The greater number of enumerations have been made with fully-eyed eggs. In connection with the returns of the number of eggs laid down furnished to the Department by the managers of several hatcheries, a few pints and half-pints have been counted by different observers, notably by Mr. FitzHerbert, of Blackcastle, shortly after fertilisation and before the delicate period of development was entered on. It must be noted that the time elapsed between the first contact with water and being counted is not stated, so that the extent to which the eggs had swelled cannot be gauged.

The process of swelling is said to be complete in twenty or thirty minutes;* we have no experiments bearing on the question of the time limit. Two observations made at Kilrea hatchery indicate that the bulk of eggs at stripping is to the same after three hours as 2:3. The maximum number of eggs per half-pint at this period is 2,118, counted by Mr. FitzHerbert within "a few hours" of stripping. The minimum is 1,820, counted by the same observer. Mr. Godfrey, of Lismore, notes that a considerable quantity of the eggs laid down there in 1902/3 were reckoned at over 200 to the fluid ounce.

As to the relation between the size of the eggs and that of the parent, such data as exist are contradictory. The largest and smallest eggs appear to come from fish of about the same weight, and Mr. Holt tells me that the smallest salmon ova which he has ever seen were stated by Mr. Scott, of Ballysodare, to have been taken from a ten-pounder.

Among the very small (eyed) eggs of one fish at Lismore, I noticed a number of conspicuously larger ones, all of which were apparently unfertilised.

* For the formula by which this is accomplished, viz.:—

$N=\frac{V\sqrt{2}}{d^3}$, where N is the number of spheres, V the volume which they occupy, and d their individual diameter, I am indebted to Mr. J. T. Jackson, of Trinity College.

* U.S.A. Manual of Fishculture, 1897, p. 46.

iii.—REPORT ON THE SALMON HATCHERY AT LISMORE.

BY

CHARLES DEANE OLIVER, B.A.I., M.INST.C.E.

PLAN AND SECTIONS.

The Department having promulgated a scheme for the development of salmon-hatching operations, the Duke of Devonshire, on the initiative of a committee of the Conservators of the Lismore district, entered into an arrangement with the Department for the erection and maintenance of a salmon hatchery at Lismore, for the improvement of the fisheries of the Blackwater.

An agreement was made for the provision at Lismore of accommodation in hatching boxes for three million (3,000,000) ova up to the eyed stage and for the transference of a portion of these at the eyed stage to certain subsidiary stations on the upper waters of the river system, where they would be duly cared and the fry distributed at the proper season, the fry resulting from ova hatched at Lismore being turned down at places accessible from the main station.

The subsidy payable by the Department was fixed at the usual rate of one shilling and sixpence (1s. 6d.) per thousand (1,000) fry turned down in suitable streams and shallows, it being provided that the maximum annual subsidy should not exceed £150.

The usual clauses, safeguarding the interests of either party, were incorporated in the agreement.

The preliminaries were settled in the late summer of 1903, and, although it seemed rather a hopeless task, it was decided to attempt to have the hatchery ready for work by December. This was in fact accomplished, mainly by the exertions of Mr. Penrose, agent to the Duke of Devonshire, and Mr. J. E. Godfrey.

Several sites were suggested, and ultimately I recommended the selection of one affording exceptional facilities in many respects, although presenting some difficulties as regards the securing of a sufficient head of water.

Here a field between the Owenshad tributary and the public road lies with a gentle slope to the south, distant only about a quarter of a mile from the hatches of the salmon weir and from one of the principal netting pools on the Blackwater, so that spawners can be easily taken and transferred by tank-cart to the holding ponds.

This field, as will be seen by reference to the plan, is entered at its north-west corner by an artificial channel, conveying a supply from the Owenshad to the Lismore canal. This supply passes along the west side of the field for some 400 feet. The channel is some 4 feet wide and 3 feet deep, with sides of masonry, and is protected from floods in the Owenshad by embankments.

At the south-west corner of the field it is joined by another supply, carried under the river by a syphon from the tail-race of a mill on the opposite bank. The combined stream runs at right angles to its former course along the south side of the field in a walled channel 220 feet long, 11 feet wide, and 4 feet deep, with gravel bottom. At the south-east corner the channel discharges into the canal at the maximum level of the latter. Both intakes are controlled by sluices.

The water supply is of good quality from a gravel subsoil in sandstone formation. At times it is much discoloured and brings down considerable quantities of road detritus, as well as of sand, causing some little trouble in the boxes, in spite of the screening operations carried out, but apparently producing no ill effects. The detritus consists mainly of limestone mud from the roads of the Owenshad valley, with a considerable

quantity of vegetable matter from woods in the valley, both in a state of extreme disintegration. Satisfactory aeration is ensured by the shallow bed and rapid flow of the Owenshad.

An area of half an acre at the southern or lower end of the field, and bounded on the west and south by the channel described, and on the east by the public road, has been enclosed as a site for the hatchery. This plot has an average level of about 2 feet 6 inches above the water of the canal. On two sides trees and shrubberies protect it considerably from the sun, while the general situation shelters it from violent winds.

The larger channel above described has been adapted to form a series of holding ponds. In these the salmon, taken at the weir, are kept for as much as six or eight weeks, or, in some cases, for three months. During this period they are examined and classified from time to time, and moved into different ponds according to degree of ripeness.

A sluice near the outlet maintains a practically uniform depth of 3 feet 6 inches of water in the ponds. They are closed by iron gratings at the syphon inlet and the junction of the upper stream. Below this point the channel is subdivided into three equal sections by divisions formed of boards, $4\frac{1}{2}$ inches wide, set vertically about $1\frac{1}{2}$ inch apart; primarily to facilitate the sorting of fish, but serving also a useful purpose in distributing the current.

When the ponds are in use the outlet sluice is raised about $1\frac{1}{2}$ inch from the bottom, and sufficient water is admitted at the intake to allow a depth of about 1 inch to flow over the top. The flow thus produced, both at bottom and top, equalises the current and keeps the bottom clean. A grating above the sluice prevents the fish from descending into the canal. A slight head is produced at each of the pond partitions, while the vertical opes in them tend to distribute the flow.

In the result a gentle uniform current, having a velocity of about one-fifth mile per hour, is maintained, in which the fish remain quiet. If it is materially increased they become fidgety, and try to push up-stream. The current, small as it is, appears to be ample, as many as 300 fish having been in the ponds together, some for three months, without loss except from accident or poachers.

For protection from poachers and vermin the ponds have been entirely encaged. Vertical posts, 12 feet apart and 7 feet high, carry rails, to which is attached "American interlaced field fencing," a species of large mesh wire-netting now on the local markets. This is supplemented near the ground by wire-netting of $1\frac{1}{2}$ inch mesh. The top is protected by lines of barbed wire stretched on transverse wires, the whole being practically impassable in any short time. The only poacher who got in could not get out, and was taken red-handed. The woodwork of all fencing is coated with "Carbolineum." At the junction of the two streams, where an eddy has somewhat deepened the bed, and where the trees afford more shade than elsewhere, the fish in the upper pond usually lie in a shoal, and here the protection has been supplemented by a barbed wire entanglement across the pond just high enough to let a man walk under it with care, the only access being from the down-stream end.

A portion of the small upper channel has been shut off by a grating and is used as a resting-place for stripped fish before they are returned to the river.

To take out fish from the pond the water is reduced until a man can conveniently wade in it with a landing-net.

The only trouble experienced has been from fish, males especially, injuring their heads against the head-grating of the upper pond in trying to get up-stream at night. This grating is of square $\frac{1}{2}$-inch iron bars, set vertically $1\frac{1}{2}$ inch apart centres, and is to be replaced before next season by a grating of wooden bars or of iron bars covered with india-rubber.

At the intermediate gratings, either because of their construction or because there is less disturbance of the water there than at the shallower and more rapid inlets and consequently less incitement to move, the fish do not seem to injure themselves.

The total head available from the intake to the canal level was only 6 feet; and this could not be materially increased without serious risk of

flooding adjacent lands, the river banks at the intake being very low and the river a mountain stream liable to very heavy spates. A low concrete weir was constructed with its crest 6 feet 6 inches above the canal level, being the maximum considered safe. The intakes for ponds and hatchery are a few feet upstream of this, and a sluice in it, immediately downstream of them, opened occasionally or maintained open when the river is high, serves to prevent accumulation of sand at their entrance, where leaf screens catch most of the floating debris of the stream.

The question of the relative levels of hatchery and intake was affected by several conditions. In the hatchery the boxes are necessarily so arranged with a view to economy of space combined with accessibility that the water passes through two in tandem. It was necessary also to provide that the lower should be at a convenient height above the floor for handling the eggs, that the upper box should be high enough to discharge into it with some fall for aeration, and that there should be clearance under the taps of the supply channel, which are set about 1 inch clear over the bottom of the supply trough.

The minimum convenient height of the top of the lower box was fixed at 2 feet 5 inches over floor.

A fall of 1 foot was considered essential in the trough.

It was, therefore, necessary to lower the floor considerably below the natural surface level.

A dry firm floor is essential, and concrete is objectionable on the score of cost and wet surface.

The whole area of the building was accordingly excavated to the level of the canal—0·00 of relative levels. The excavation was filled in with 18 inches of rubble stone, with drain tiles laid through them, and a 12-inch pipe-drain was carried to the outlet downstream of the lower sluice of the holding ponds. Over the rubble was laid 4 inches of graduated gravel finished with sharp sand.

The floor being below the water level of the ponds and the intermediate soil somewhat porous, a catch drain was constructed between the ponds and building at the outlet level, formed of 12-inch drain-pipes with open joints, surrounded by rubble stone. To this are also connected the pipes having the discharge from the boxes.

An embankment sufficient to protect the hatchery against the effects of any recorded flood has been carried round the building. The supply trough and a waste trough conveying excess supply pass through the top of this embankment. The latter discharges into a surface drain leading to the canal. The outlet of all drains and discharges being thus direct into the canal, the level of which is unaffected by floods, the hatchery is believed to be perfectly secured.

As will be seen from the above description, 1 foot of fall was allowed for the water supply to the boxes from the head weir. It was estimated that a rectangular channel, 8 inches by 6 inches, would give the necessary supply; but as it was cheapest to construct this of timber, it was thought as well, the cost of workmanship being almost identical, to make the trough of 11 inches by 9 inches. The extra supply of water thus obtained proved, as will be seen, useful in many ways.

For a part of its length the trough rests upon the ground or is embedded in an embankment; where it is above the ground level it is carried on supports about 12 feet apart.

It is covered by boards secured by screws, so that any part can easily be exposed if required.

Coarse screens are also provided across the supply shoot.

The woodwork of the shoot is of unplaned deal, coated with a well-boiled mixture of coal-tar and pitch.

The supply of water given to the boxes is at the rate of 250 gallons per box per hour, equivalent to 5 galls. per hour per 1,000 ova, laid in a double layer. This supply has proved ample even for the double layer of ova, and has been found to be more than is required for the number of alevins which can safely be kept in a box.

The supply is regulated so as to be always up to an overflow at the outlet end, thus keeping a constant head over the taps of 4 inches. Mr. Penrose has devised a tell-tale, consisting of a heavy float, which rings a

bell and calls the attention of the watchman whenever, from obstruction of the screens or other cause, the head falls below the desired level.

To check the inflow of sand there is inserted, at the point where the trough crosses the pond supply, a weir board, in front of which are holes in the bottom, the discharge through which carries away any sand collected on the bottom. At the same place a side overflow gets rid of much floating debris.

The supply taps for the boxes are wooden cider barrel taps, of ⅞-inch bore inlet and ⅝-inch outlet.

The overflow from the boxes is taken by a wooden trough laid on the ground, divided into three sections, and connected with the outlet drains.

In addition to the water supply of the hatchery described above, a supplemental supply has been connected from the town main, which passes close by, by means of a 2-inch pipe under a head of some 300 feet. In addition to acting as a reserve this is convenient for flushing and washing purposes.

While the silt brought down has not been found actually deleterious, it is troublesome, and screens have been provided, which are generally used. These consist of two thicknesses of bolting-cloth supported by wire-netting, and having a total area of about 36 square feet, through which the water rises vertically under a head of about 4 inches. They by no means retain all the silt, but reduce it materially. They are easily cleaned by shutting off the water for a few minutes and turning the hose over them, a sluice in the bottom of the tank passing out the silt. They are made in two sections, so that for special cleaning or repairs one can, if necessary, be put out of action. While, as before stated, the silt is not found to exercise any deleterious effect on the ova, it is so troublesome in cleaning and sorting operations that probably, as a measure of economy, the screens will be increased and made more efficient.

In Herr Jaffé's boxes the sand and silt removed by periodic flushings escapes through a hole closed by a plug. The removal of this being thought to cause an objectionable jar, a very neat arrangement has been devised by Mr. J. E. Godfrey, by which any jar is entirely avoided.

A lead nozzle is inserted in the waste hole, and to it is attached a short length of 1½-inch rubber hose. The end of this is raised above water level, and there secured. For flushing it is merely necessary to drop it. A portable wooden shoot is provided to lead the water to the discharge trough, and the life of the rubber hose is insured by keeping it in water during the time when the hatchery is not working. From the standpoint of strict economy this contrivance is perhaps a luxury rather than a necessity; but, since it precludes the possibility of the boxes being jarred by careless removal or replacement of the waste-plugs, it is probably worth the small extra cost which it involves. It also saves time.

The boxes used are Jaffé's Sandfort Incubating and Hatching Boxes.* The hatching-boxes have, for economy, been made as "twins," two boxes of the stock size being contained, side by side, in the same frame. The incubating boxes depart from Jaffé's model in that they have been provided with similar screens and outlet weirs to the hatching boxes. All the boxes are provided with trays of both coarse and fine perforated zinc, so that they can be used for all stages of incubation and hatching. In effect it has been found that, with these modifications, one form of box is as efficient as the other, under the conditions of supply and quality of water obtaining at Lismore.

In the model incubating and hatching boxes supplied by Herr Jaffé, and described and figured by Mr. C. Green,* the trays rest on nails projecting from the sides of the box. In the first season's work at Lismore these nails were found a source of injury to the attendant's hands when cleaning the boxes, and have accordingly been replaced by ledges.

The boxes are coated outside with tar mixture and inside with "Asphaltum" varnish, supplied by Sissons Bros., Hull.

The hatchery building was originally designed as a roof only, carried on wooden posts, but it has been found that, while the temperature does not fall low enough to do any harm to the ova, it is far too cold for the

* "Drawings and Descriptions of Apparatus used in Salmon and Trout Culture. . . . *Ann. Rep. Fisheries (Ireland)*, 1901, Pt. II.; Appendix, XIV. pp. 197–204

men to work, although in Co. Kerry all the hatcheries are in the open air, without even a roof, and the climate appears to allow of their efficient care. The sides have accordingly been closed in. The whole is of galvanised corrugated iron on larch framing.

Light is afforded by skylights 2 feet by 18 inches, set 8 feet apart centres.

For holding fish selected for stripping, two tanks have been provided. They are each 6 feet by 6 feet, and 3 feet and 2 feet 6 inches deep respectively, and are fed by the overflow weir of the supply trough. On occasion fish have been kept overnight in these without injurious result, but as a rule the tanks are only used during the progress of actual stripping operations.

The hatchery was designed to afford accommodation for the probable maximum number of ova available only while they are in the earlier stages of development. The hatching out of a considerable proportion, after reaching the eyed stage, has to be provided for elsewhere.

This is intended to be done by the use at Lismore and at out-stations on the upper waters, in places suitable for turning down the fry, of "Floating redds" of Herr Jaffé's Sandfort pattern. The development of hatching stations on the upper waters is as yet incomplete, and, so far, the redds have only been used in the holding ponds at Lismore and on the Funcheon and Awbeg, tributaries of the Blackwater, at Rockmills and Annesgrove, respectively.

Of the fry from the hatchery at Lismore, some are turned down in the Owenshad, but a considerable proportion are sent by rail to the upper waters of the Blackwater. They are conveyed in carboys of the kind used for sulphuric acid, and, with the careful attention which is bestowed on them, do not appear to suffer at all in transit, which occupies two or three hours.

The fry hatched in the floating redds at Lismore are allowed to escape into the holding ponds, from which they can pass either into the Owenshad or the Lismore canal, and thence, in due course, to the sea.

At the out-stations also the fry are liberated direct from the redds. At Rockmills the large disused mill-stream, in which the redds are moored, is grated, and all trout are cleared out before the fry are liberated. The gratings offer no obstruction to the escape of the fry while still minute, and are removed when they are about six months old.

At Annesgrove the fry pass at once into the Awbeg.

As regards the working of the "Floating Redds"—where at Lismore and Rockmills these are moored in a gentle current under control and maintained at about half a mile per hour, they have been absolutely successful; the loss at Rockmills from the time of leaving the hatchery to the turning out of the fry, including that due to about twenty miles journey by rail and road, being under 3 per cent.

At Annesgrove, where the stream is not under control and in floods brings down a large quantity of sand, trouble was experienced by this getting into the boxes and, in some cases, causing them to sink. In other cases the turbulence of the current spilled a number of ova from the trays, with the result that they were suffocated in the sand at the bottom of the redd. A method of getting rid of the sand after floods presents no great difficulty, but pending successful experiment with floating breakwaters to prevent undue agitation of the redds, Annesgrove will not again be used as a hatching station.

In Jaffé's Redds the trays are designed to rest by their own weight on pegs a few inches above the bottom, the thickness of the perforated zinc being sufficient to sink the wooden parts of the tray. A difference in the weight of the zinc supplied for the Lismore trays caused the latter to float. Though the ova were thus brought within a few inches of the surface, and thus fully exposed to the light through the wire-netting of the lids of the redd, no evil results were experienced at Lismore and Rockmills. At Annesgrove, however, the agitation of the redds caused the trays to ride one over the other, and with the trays floating loose this might happen with only a moderate disturbance of the surface.

Experience showed that great difficulty would have been found in giving proper attention to the trays had they remained at the designed depth in the redd, since some of the ova would certainly have been spilled

in lifting the trays for removal of dead or in replacing them. Their flotation was therefore so far advantageous, but to guard against risks of violent current or strong surface motion, which may occur even in the most sheltered situation, precautions have been taken to keep the trays fixed. Ledges fixed to the sides of the redd have been substituted for the pegs, giving the trays a substantial bearing.

A frame of two longitudinals, with cross battens on top, rests on the trays, and is in turn pressed down by the lids of the redd. Being of suitable depth, it brings the trays to their bearing when the lids are closed. Reference to the working drawings of the redd, given in the Report for 1901,* will at once explain the details involved in this arrangement, which, so far as the experience of it goes, up to the present, appears to be a decided improvement.

In manipulation the top frame is carefully lifted off the trays, which float evenly to the surface and are attended to. The frame is then evenly relaid on the trays, and both lids of the redd are gradually closed, and secured by the buttons.

The redds, when moored singly, were found lacking in stability, and were accordingly arranged in pairs connected by cross-battens under the ends of the "floats." For their proper care it was found necessary that the attendant should wade in the stream, and wading boots or trousers are therefore a necessary expense in connection with this form of fish culture.

A schedule showing the cost of various portions of the work is appended. The total cost is influenced by so many circumstances, including the nature of the site and the facilities for supplying material and labour, that it cannot be taken as even an approximate guide for other cases.

The existence of a masonry channel with head-sluices offered exceptional facilities for holding ponds.

On the other hand, there was perhaps exceptional necessity for the adequate protection of the holding ponds, while the precautions taken against unusual floods involved an expense which would be unnecessary in many places.

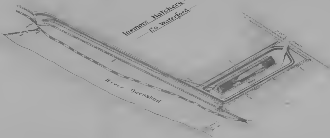
Probably, saving could have been effected in various items had time been less pressing. Again, the fact that considerable quantities of second-hand drain-pipes and other material were available from the Lismore Castle stores at cheap rates, led to the construction of drains in a form which, though intrinsically cheap and very effective, would hardly be adopted elsewhere.

A general diagrammatic plan of the hatchery in isometric projection and two sheets of cross sections are annexed.

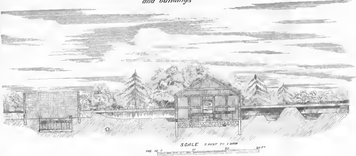
LISMORE HATCHERY.—DETAILS OF COST.

		£	s.	d.
Building 140 feet by 20 feet, 24,000 c. ft.,		195	0	0
Floating Redds,	each,	1	7	6
Twin Hatching Box,	each,	0	16	0
Single do.,	each,	0	11	0
Single Incubating Box,	each,	0	13	0
Trestles,	per pair,	0	2	2
Trough, 11 in. by 9 in. (including supports),	per foot,	0	1	6
Enclosure of Ponds,	per yard run,	0	7	6
Cocks for Water Supply,	average each,	0	0	6
Hose and connexion for Flushing Out,	per box,	0	1	6

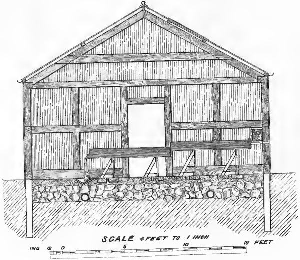
* *loc. cit.*


Lismore Hatchery
Co Waterford
River Owenshad

Lismore Hatchery.
Section through ponds and buildings



Lismore Hatchery.
Section of building



Appendix, No. XII.

STATISTICAL INFORMATION RELATING TO THE SALMON FISHERIES.

By the courtesy of the gentlemen whose names appear below, it is possible to give the following Returns in continuation of those which appeared in our Reports for 1900 and 1901, and in the Report of the Irish Inland Fisheries Commission (Appendix, Part II., xxiii).

PERCENTAGES OF WEIGHT OF TAKE ABOVE AND BELOW AN AVERAGE FOR TWENTY-FIVE YEARS ENDING 1899 (*TWENTY-THREE YEARS IN THE CASE OF THE LAX WEIR FISHERIES*).

Blackwater, Lismore. — Mr. R. Foley.

1900,	40 per cent. below.
1901,	57 ,, ,,
1902,	35 ,, ,,
1903,	18 ,, ,,

The killing hatch was kept open for alternate fortnights during the first three months of 1902; in 1901 it was open throughout the first three months; in 1903 during February, March and April.

Mr. Foley writes in 1902:—"This has been a most unusual season. It began with a fair run of spring fish about the middle of December . . . There was a good show of spring fish up to the end of January, when a flood took them up before our season opened on 1st February. The run in February was small, and so was March and April. In fact the spring fishing was bad, and it was not until June there was any improvement, when there was a remarkable improvement in the run of grilse."

A diagram supplied by Mr. Foley shows that the improvement of grilse, noted in 1902, was rather more than maintained in 1903; but the chief source of improvement was in salmon.

Blackwater, Co. Kerry. — Mr. R. M'Clure.

1900,	30 per cent. below.
1901,	42·7 ,, ,,
1902,	10·5 ,, above.
1903,	38·6 ,, below.

Waterville, Co. Kerry. — Mr. J. E. Butler.

1900,	52* per cent. below.
1901,	48 ,, ,,
1902,	26 ,, ,,
1903,	43 ,, ,,

Laune, below Killorglin Bridge. — Mr. R. Power.

1900,	47 per cent. below the average of the twenty-four years ending 1894.
1901,	55 per cent. below ditto.
1902,	12 per cent. below the average of the twenty-four years ended 1898.
1903,	12 per cent. below ditto.

Mr. Power notes that spring fishing was greatly interrupted by floods in March, 1903, and that there was an unusual abundance of fish at the end of that season.

* Given incorrectly in previous reports.

Lax Weir (including weir and nets), Shannon. Mr. J. A. Place.

1900,	39 per cent. below.
1901,	39 ,, ,,
1902,	74 ,, above.
1903,	4 ,, below.

Mr. Place writes:—"The grilse season of 1903 was unsatisfactory, compared with that of 1902; at the same time the season was, as regards grilse, distinctly an average one for this fishery. . . I believe the grilse season of 1902 to have been the best within living memory."

Bann Nets. Mr. T. M'Dermott.

1900,	37 per cent. below.
1901,	46·75 ,, ,,
1902,	9·75 ,, ,,
1903,	17 ,, ,,

Foyle Nets. Mr. T. M'Dermott.

1900,	45 per cent. below.
1901,	39·75 ,, ,,
1902,	31·75 ,, ,,
1903,	6·5 ,, above

Erne Nets. Mr. T. M'Dermott.

1900,	44 per cent. below.
1901,	44 ,, ,,
1902,	1 ,, above.
1903,	30 ,, below.

Erne Angling. Mr. T. M'Dermott.

1900,	31·25 per cent. below.
1901,	38 ,, ,,
1902,	26·2 ,, ,,
1903,	13 ,, ,,

Moy Tidal. Mr. J. Garvey.

1900,	Lower than 1901.
1901,	50 per cent. below.
1902,	5 per cent. above.
1903,	10 per cent. above average of good years.

Mr. Garvey writes:—"In my experience we never had so many breeding fish as in the season of 1903." All nets were taken off a fortnight before the end of the season in 1902 and 1903.

OTHER RETURNS.

Snir.—Cahir Park and Neddin's Water. Mr. W. Rochfort.

Cahir Park. — 1900,	37 salmon,	weighing	392 lbs.
1901,	24 ,,	,,	424¾ ,,
1902,	21 ,,	,,	207½ ,,
1903,			
Neddin's Water.—1900,	62 ,,	,,	603 ,,
1901,	23 ,,	,,	480 ,,
1902,	9 ,,	,,	78 ,,
1903,			

Ownavarra R., Co. Wexford. The Right Hon. the Earl of Courtown.

1900. Salmon, 15. White Trout, 148.

1901. Lord Courtown wrote:—"The run of salmon showed no marked improvement, but may have been unfavourably affected by the weather. The few salmon that have been taken this season have been much above the average weight of fish taken in the Ownavarra. The run of white trout showed a considerable improvement."

1902. Salmon, 28.
The average for the twenty-five years ended 1899 was eighty-one, but this average does not correctly show the amount usually caught, as over 120 salmon were caught in each of the five years 1891 to 1895. More salmon were caught in 1902 than in any of the three preceding years.

Castleconnell Angling. Mr. S. C. Vansittart.

—		Salmon. 1st Feb. to 31st May.	Salmon. 1st June to 31st Oct.	Peal. 1st Feb. to 31st May.	Peal. 1st June to 31st Oct.	Total for Season Salmon.	Total for Season Peal.	Total.
Worldsend and Erinagh.	1900,	8	5	–	6	13	6	19
	1901,	12	6	–	3	18	3	21
	1902,	26	5	–	4	31	4	35
	1903,	13	4	–	10	17	10	27
Newgarden, .	1900,	16	1	–	47	17	47	64
	1901,	30	1	1	66	31	67	98
	1902,	24	1	–	16	25	16	41
	1903,	25	5	–	90	30	90	120*
Summerhill and Castle.	1900	16	5	–	25	21	25	46
	1901,	14	5	–	9	19	9	28
	1902,	25	9	–	13	34	13	47
	1903,	26	5	–	20	31	20	51
Woodlands, .	1900,	12	4	–	4	16	4	20
	1901,	12	2	–	13	14	13	27
	1902,	12	2	–	12	14	12	26
	1903,	8	2	–	3	10	3	13†
Doonass, .	1900,	14	12	–	38	26	38	64
	1901,	34	12	1	49	46	50	96
	1902,	34	4	–	36	38	36	74
	1903,	48	5	–	38	53	38	91
Hermitage, .	1900,	16	10	–	28	26	28	54
	1901,	19	3	–	25	22	25	47
	1902,	21	10	–	46	31	46	77
	1903,	27	11	–	35	38	35	73
Landscape, .	1900,	4	2	–	11	6	11	17
	1901,	2	2	–	–	4	–	4
	1902,	8	3	–	40	11	40	51
	1903,	8	–	–	15	8	15	23†
Prospect, .	1900,	13	4	–	27	17	27	44
	1901,	17	5	–	25	22	25	47
	1902,	18	6	–	43	24	43	67
	1903,	13	–	–	68	13	68	81*

* To 31st July only. † To 30th June only.

Mr. Vansittart writes in 1903:—"The peal season was bad."

Waterville Salmon Fishery. | Mr. J. E. Butler.

—	Jan. 1st to 16th.	Jan. 16th to 31st.	February.	March.	April.	May.	June.	July.	Total.
1900, . .	31	23	33	9	35	35	86	47	299
1901, . .	21	42	25	46	70	15	69	41	329
1902, . .	29	11	29	26	32	13	279	82	501
1903, . .	44	39	72	47	6	16	84	49	357

Blackwater—Dromana Fishery. | Mr. Villiers Stuart.

—	Salmon.	Peal.	Total.
1900, . .	290	480	770
1901, . .	262	220	482
1902, . .	217	1,076	1,293
1903, . .	324	525	849

RETURNS OF IRISH SALMON FROM BILLINGSGATE.

Mr. J. Wrench Towse.

—	Number of Boxes of Irish Salmon.			Average Price per lb.			No. of Boxes from all sources.*		
	1901.	1902.	1903.	1901	1902.	1903.	1901.	1902.	1903.
				s. d.	s. d.	s. d.			
January, ...	35	27	32	4 0	3 5	3 11¼	134	197	165
February, ...	207	212	227	2 0	2 3	2 0	906	807	977
March, ...	407	279	359	2 1	2 5	2 5	1,530	1,153	1,387
April, ...	580	354	586	2 1	2 7	2 0½	2,148	1,564	2,062
May, ...	837	635	789	1 7½	2 2	1 7	3,651	2,862	3,552
June, ...	1,007	2,792	1,571	1 5	1 7	1 3½	4,705	6,381	5,859
July, ...	1,383	2,586	4,245	1 4	1 1	1 2	7,291	9,379	9,357
August, ...	56	88	226	1 4½	1 2	1 2	3,576	3,934	3,863
September, ...	2	1	1	1 6	1 8	1 6	663	744	893
October, ...	-	-	-	-	-	-	33	100	154
November, ...	-	-	-	-	-	-	48	33	56
December ...	-	-	-	-	-	-	70	34	92
	4,514	6,974	8,036	-	-	-	24,755	27,188	28,407

* Including English, Scotch, Irish, Dutch, Norwegian, German, French, Danish, and Canadian.

APPENDIX, No. XIII.

SUBSTANCE OF REPORTS RECEIVED FROM CLERKS OF CONSERVATORS RELATIVE TO SALMON FISHERIES.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	What is the general state of the Salmon Fisheries in this District? Are they as a rule improving or declining? 1902.	1903.
Dublin,	Fair; slight improvement,	Fair; slight improvement,
Wexford,	Improving,	Improving,
Waterford,	Fair; improving,	Improving; the open season as regards take of Salmon was the best for the past twenty years.
Lismore,	No improvement in rod or net fishing until the run of peal in May, June, and July which was better than previous years.	Good; improving,
Cork,	Fair; declining,	Fairly good; declining,
Cork (Bandon),	Fairly good; slight improvement,	Good; improving,
Skibbereen,	Fair; good season for nets; improving,	Great improvement; has been the best season for net fishermen for some years.
Bantry,	Better than last three years; improving,	Good; improving,
Kenmare,	Fair; improving,	Fair, but not so good as in previous years,
Waterville,	Poor; about the same as last year,	Fair. No change for the past two years,
Killarney,	Fair; slight improvement,	Fair; improving,
Limerick,	Great improvement,	On the whole more satisfactory than in recent depressed years.
Galway,	Good, improving; best year for Galway fishery, both as regards run and catch since 1891.	Not so good as last year, either as to supply or capture.
Connemara,	Bad; declining,	Fair; improving,
Ballinakill,	Very much improved,	Declined since last year,
Bangor,	Healthy; improving,	Not so good as in preceding year; declining
Ballina,	A decided improvement on last few years,	Fair; improving,
Sligo,	Very good; fish improving in weight and quantity.	Fair; improving,
Ballyshannon,	Improving,	Good; neither improving or declining,
Letterkenny,	Fairly good; slight improvement,	Fair,
Londonderry,	Fairly satisfactory; improving,	Satisfactory; improved,
Coleraine,	Improving,	Not quite so good as last season,
Ballycastle,	Declining,	Declining,
Dundalk,	Generally satisfactory, except the Castletown River in which the salmon fishing is declining.	Generally very good; improving,
Drogheda,	Improving as regards Grilse; Spring fishing bad.	A general improvement on preceding year,

No. XIII.

of CONSERVATORS relative to SALMON FISHERIES.

Has the take of Salmon and Grilse by nets and weirs throughout the district been more, or less, productive in the present year than in the past one? 1902.	1903.	DISTRICT.
Less,	More productive,	Dublin.
Take of Salmon about the same. Large improvement in take of Grilse by nets.	More Salmon—less Grilse,	Wexford.
More productive, especially as regards Grilse.	Far more Salmon, but less Grilse,	Waterford.
The take generally shows a slight increase, due to the good run of peal.	The take generally shows a very good increase as compared with previous years	Lismore.
Considerably less,	Less productive,	Cork.
More productive,	More productive,	Cork (Bandon).
More productive,	More productive,	Skibbereen.
More productive,	Less productive,	Bantry.
More productive; very good year,	Less productive,	Kenmare.
Salmon about the same; Grilse more productive.	Less productive,	Waterville.
Salmon about the same; Grilse more productive.	More productive,	Killarney.
Take of Salmon poor, but that of Grilse largest for many years.	Less productive,	Limerick.
More productive,	Less productive	Galway.
—	—	Connemara.
Very much more productive,	Very much less,	Ballinakill.
Much more productive,	Less productive,	Bangor.
More productive,	Slightly more productive,	Ballina.
More productive in Ballisodare; slightly less in Sligo River.	About the same,	Sligo.
More productive,	Less productive,	Ballyshannon.
More productive,	More productive,	Letterkenny.
More productive,	More productive,	Londonderry.
More productive,	Less productive,	Coleraine.
Less productive,	Less productive,	Ballycastle.
More productive, except Castletown River,	More productive,	Dundalk.
Slightly more productive,	An increase in the take of Salmon, but not in that of Grilse.	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Has the take of Sea Trout by nets and weirs been more, or less, productive this year than in the past one? 1902.	1903.
Dublin.	Less productive,	Less productive,
Wexford,	More productive,	More productive,
Waterford,	Very little Sea Trout taken in this District,	Very little netting for Sea Trout.
Lismore,	Very poor; a smaller class of fish,	More productive,
Cork,	—	About the same,
Cork (Bandon),	No netting for Sea Trout,	More productive,
Skibbereen,	More productive,	More productive,
Bantry,	More productive,	Less productive,
Kenmare,	No netting for Sea Trout in the district,	No nets for Sea Trout used in this district,
Waterville,	Less productive,	Very few Sea Trout taken in the district by nets.
Killarney,	About the same,	About the same,
Limerick,	None taken in Shannon for commercial purposes.	This kind of fishing is never of any consequence in the Shannon.
Galway,	More productive,	Less productive,
Connemara	—	—
Ballinakill,	Less productive,	Very much less,
Bangor,	Less productive,	Less productive,
Ballina,	Not more productive,	No,
Sligo,	A fair take of Trout,	No,
Ballyshannon.	About the same. Very little fishing for Sea Trout.	Slightly more productive in River Erne,
Letterkenny,	No change,	More productive,
Londonderry,	About the same,	More productive,
Coleraine,	More productive,	Less productive
Ballycastle,	Very few taken,	Very few taken,
Dundalk,	Less productive,	Less productive,
Drogheda,	Less productive,	Considerably less,

N . XIII.—*continued.*

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

Has any peculiarity been observed in the date at which fish have appeared in the rivers this season ?		DISTRICT.
1902.	1903.	
They appeared earlier than usual, .	Earlier than usual, ...	Dublin.
No, ...	Grilse were late, ...	Wexford.
The run of Salmon in freshwater of Rivers Barrow and Nore was late (about May).	No, ...	Waterford.
No, ...	No, ...	Lismore.
No, ...	No, ...	Cork.
Spring fish were late in arriving, . .	No, ...	Cork (Bandon)
No, ...	No, ...	Skibbereen.
No, ...	No, ...	Bantry.
No, ...	No, . . .	Kenmare.
No, ...	No, ...	Waterville.
No, ...	No, ...	Killarney.
No, ...	No, ...	Limerick.
Spring fish late. Run of Grilse early, .	No, ...	Galway.
No, ...	No, ...	Connemara.
No, ...	No, ...	Ballinakill.
No, ...	No, ...	Bangor.
No, ...	Grilse were later in running, . .	Ballina.
Sligo opened 1st January—not many fish, snowy water. All fish caught were healthy.	No, ...	Sligo.
No, ...	Fish appeared in the rivers about two weeks later.	Ballyshannon
No, ...	No, ...	Letterkenny.
No, ...	No, ...	Londonderry.
No, ...	No, ...	Coleraine.
The run was late, and the Grilse smaller than usual.	No, ...	Ballycastle.
No, ...	No, ...	Dundalk.
Fish appeared very late, . . .	Grilse and White Trout about fourteen days later than in previous year.	Drogheda.

APPENDIX,

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Between what dates did the principal migration of smolts take place? Was it larger or smaller than usual? 1902.	1903.
Dublin, . .	April and May. Larger than usual, .	May and June—also in the Autumn. Larger.
Wexford, . .	April and May. Larger than usual, .	March and April. Larger, . .
Waterford, . .	March, April, and May. Somewhat larger than of late years.	End of March, April, and May. Larger. On Barrow run continued longer than usual. General run very good. About same as in 1902.
Lismore, . .	From middle of March to May, Larger than usual, . . .	From 17th March to end of May. Much larger.
Cork, . .	About the average, . .	Between 5th and 28th March, .
Cork (Bandon), .	April. Much larger, . . .	Between 1st April and 1st May, . Much larger.
Skibbereen, .	April. Same as usual, . . .	Between 6th April and 9th May Average,
Bantry, . .	April and May. Larger this year, .	April and May. As usual, . .
Kenmare, . .	About March. Cannot say, . .	April and May, ...
Waterville, . .	March to May. Same as usual, . .	April and May. No change, . .
Killarney, . .	March to May. Larger, . . .	March to May, inclusive. About the same,
Limerick, . .	April and May. Very much larger, .	April and May. Average, . .
Galway, . .	April and May. Rather larger, . .	April and May. Average, . .
Connemara, .	April to May. About the same, . .	April and May. Average, . .
Ballinakill, . .	—	Cannot say, ...
Bangor, . .	20th April to end of June. Larger, .	End of April to end of May. About the same.
Ballina, . .	April and May. Not larger, . .	April and May, ...
Sligo, . .	April, May, and June. Larger, . .	About 12th May to middle of June. Larger,
Ballyshannon, .	15th April to end of May. Larger, .	April and May. Larger, . . .
Letterkenny, .	Could not be ascertained, . . .	Date not known, . . .
Londonderry, .	1st April to 1st June. Somewhat larger,	1st April and 15th June. About the same,
Coleraine, . .	March to end of June. Much larger, .	Early in April to end of June. Average,
Ballycastle, .	Latter end of May. Average, . .	End of May to beginning of June. Average,
Dundalk, . .	10th to 25th May. No change except in Castletown River in which it was smaller.	Between 1st and 31st May. No change, .
Drogheda, . .	April and June. Larger, . . .	April and May. Larger, . . .

No. XIII.—*continued.*

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

Has there been observed more than one migration of Smolts to the sea during the season? If so, state dates when these migrations took place. 1902.	1903.	DISTRICT.
Yes; in July and September,	Yes; late in August,	Dublin.
Yes; on April 5th (?)	Yes; on 8th May,	Wexford.
A later migration than usual was noticed in the Suir in June.	No,	Waterford.
No,	No,	Lismore.
No,	No,	Cork.
No,	No,	Cork (Bandon).
No,	No,	Skibbereen.
No,	No,	Bantry.
No,	None observed,	Kenmare
No,	No,	Waterville.
No,	No,	Killarney.
Yes; there is an Autumn run,	Yes; in September,	Limerick.
Yes; small run in September and October,	Yes; in September,	Galway.
No,	No,	Connemara.
——	Cannot say,	Ballinakill.
No,	No,	Bangor.
Yes; several in April and May,	No,	Ballina.
Pretty constantly during April, May, and June.	Yes; but date not noted,	Sligo.
No,	No,	Ballyshannon.
No,	No,	Letterkenny.
Yes; cannot give dates,	Yes; but date not noted,	Londonderry.
Several migrations with each flood from 10th March to end of June.	No.	Coleraine.
No,	No,	Ballycastle.
Not more than in previous years,	No,	Dundalk.
Yes; April to June, and in October,	No,	Drogheda.

APPENDIX,

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	In your opinion was the weather favourable or (I.) To Netting. 1902.	1903.
Dublin,	Favourable,	Favourable,
Wexford,	Favourable,	Unfavourable,
Waterford,	Favourable,	Favourable,
Lismore,	February and March extremely cold; weather otherwise very favourable.	Favourable,
Cork,	Favourable,	Unfavourable,
Cork (Bandon),	Favourable,	Unfavourable for first four or five weeks
Skibbereen,	Favourable,	Favourable,
Bantry,	Favourable,	Unfavourable,
Kenmare,	Favourable,	Favourable to middle of July,
Waterville	Favourable,	Unfavourable,
Killarney,	Favourable,	Part of the season was unfavourable in the rivers owing to floods, but favourable in the lakes.
Limerick,	Favourable,	Very unfavourable in Spring—normal in Summer.
Galway,	Generally favourable,	Unfavourable in Spring; moderately favourable during Summer months.
Connemara,	Favourable,	Unfavourable,
Ballinakill,	Very favourable,	Unfavourable,
Bangor,	Favourable,	Unfavourable,
Ballina,	Favourable.	Favourable,
Sligo,	Favourable,	Favourable,
Ballyshannon	Favourable,	Favourable in the beginning, but unfavourable in the latter part of the season,
Letterkenny,	Favourable,	Favourable,
Londonderry,	Unfavourable,	Fairly favourable,
Coleraine,	The weather was more favourable to netting than angling during greater part of season. Most unfavourable to draft nets in the sea.	Favourable in inland waters, unfavourable in the tidal.
Ballycastle,	Unfavourable,	Unfavourable,
Dundalk,	Favourable,	Favourable on the whole, but to some extent interrupted by floods.
Drogheda,	Unfavourable,	The heavy waters subsequent to the storm of 26th February, 1903, interfered with both angling and netting in the upper waters.

No. XIII.—*continued.*

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

unfavourable in each month of the open season? (ii.) To Angling.		DISTRICT.
1902.	1903.	
Unfavourable,	Favourable,	Dublin.
Favourable,	Favourable,	Wexford.
Favourable on the average,	Favourable,	Waterford.
Unfavourable; water too low from June to September, and February and March. too cold.	Favourable,	Lismore.
Favourable,	Unfavourable,	Cork.
Unfavourable,	Favourable,	Cork (Bandon).
Very unfavourable,	Favourable,	Skibbereen.
Unfavourable until October,	Favourable,	Bantry.
Favourable,	Favourable to middle of July,	Kenmare.
In Spring and Summer favourable. In Autumn unfavourable; weather dry and water low and bright.	Unfavourable,	Waterville.
Favourable in Spring and Summer. Unfavourable in Autumn.	Favourable on the whole,	Killarney.
Unfavourable, owing to dry weather,	Very favourable for some districts. Unfavourable in others.	Limerick.
Generally unfavourable owing to unsettled weather in the Spring, and low water later in the season.	Very unfavourable during February, March, and April. Moderately favourable in May, June, and July.	Galway.
Unfavourable,	Favourable,	Connemara.
Not so favourable,	Favourable,	Ballinakill.
Favourable,	Favourable,	Bangor.
Favourable,	Favourable,	Ballina.
Unfavourable,	Favourable,	Sligo.
Favourable,	Favourable,	Ballyshannon.
Unfavourable, except in September and October.	Favourable,	Letterkenny.
Favourable,	Favourable,	Londonderry.
—	Unfavourable,	Coleraine.
Unfavourable,	Unfavourable in early part of season, improved towards the end.	Ballycastle.
Favourable,	Favourable,	Dundalk.
Unfavourable,	The heavy waters subsequent to the storm of 26th February, 1903, interfered with both angling and netting in the upper waters.	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	At what period of the year is Grilse first taken?	
	1902.	1903.
Dublin,	June,	June,
Wexford,	June,	June, July, and August,
Waterford,	About May in tidal waters,	June,
Lismore,	10th May,	Early in May
Cork,	June and July,	Early in May,
Cork (Bandon),	About middle of June,	Middle of June,
Skibbereen,	End of June	End of June,
Bantry	July,	July,
Kenmare.	June	June,
Waterville,	Latter end of May,	June,
Killarney,	End of May,	End of May,
Limerick,	Last week in May.	End of May,
Galway,	12th May,	End of May,
Connemara,	Ballinahinch 1st June—other fisheries middle to end of June.	June,
Ballinakill,	June,	Middle of June,
Bangor,	May,	End of May,
Ballina,	May,	June,
Sligo,	About 12th June,	About middle of May,
Ballyshannon,	1st week in June,	June,
Letterkenny,	June,	June,
Londonderry,	End of May,	End of May
Coleraine,	End of May to 12th June,	End of May
Ballycastle	Second week in May,	Middle of May,
Dundalk,	August,	June,
Drogheda,	June,	June,

No. XIII.—*continued.*

of Conservators relative to Salmon Fisheries—*continued.*

During what months is the greatest quantity observed or taken?		District.
1902.	1903.	
July,	End of July,	Dublin.
July and August,	July,	Wexford.
August,	July and August,	Waterford.
June and July,	June and July,	Lismore.
June,	June and July,	Cork.
July,	June and July,	Cork (Bandon).
–	August,	Skibbereen.
July,	July,	Bantry.
July,	July,	Kenmare.
June and July	August,	Waterville.
June,	June and July,	Killarney.
June,	June,	Limerick.
June,	June and July,	Galway.
Ballinahinch June—other fisheries July,	June and July,	Connemara.
July,	June and July,	Ballinakill.
July,	July,	Bangor.
June and July,	June and July,	Ballina.
End of June,	End of June,	Sligo.
June,	July,	Ballyshannon.
June, July, and part of August,	June to August,	Letterkenny.
July,	July,	Londonderry.
End of June and beginning of July,	July,	Coleraine.
Last half June and first half July,	Middle of June to middle of July,	Ballycastle.
End of August,	July,	Dundalk.
July,	July,	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	During what months are many Salmon taken with the Grilse, and are these Salmon on an average heavier or lighter than at other periods? 1902.	1903.
Dublin,	Latter end of June; heavier,	June; heavier,
Wexford,	June, August, and September; heavier,	June; heavier,
Waterford,	July and August; lighter as a rule,	July and August; lighter,
Lismore,	May and June,	May and June; lighter,
Cork,	July; about the same weight,	April and May; about the same,
Cork (Bandon),	June and July; lighter,	June and July; heavier,
Skibbereen,	July and August; heavier,	July and August; heavier,
Bantry,	June and July; heavier,	June and July; heavier,
Kenmare,	July,	July; heavier,
Waterville,	June and July; somewhat heavier,	July; lighter,
Killarney,	June; heavier as a rule,	June; heavier,
Limerick,	May; lighter,	May; lighter,
Galway,	July; lighter,	June and July; lighter,
Connemara.	July and August; heavier at Ballinahinch, about the same weight at other fisheries.	July and August; heavier at Ballinahinch, average elsewhere.
Ballinakill,	June; much the same,	June; same weight,
Bangor,	May and June; heavier,	May and June; heavier,
Ballina.	June and July; the same weight,	June and July; same weight,
Sligo,	June and July; no difference in weight,	May to July; heavier,
Ballyshannon,	June and first week in July; heavier,	June and July; very little difference,
Letterkenny,	June to end of August,	June and July,
Londonderry,	June, July, and August,	June to August,
Coleraine,	June and July; lighter than those taken at end of July and beginning of August.	May and June; lighter,.
Ballycastle,	—	—
Dundalk,	August and September; heavier,	July and August; lighter,
Drogheda,	July; lighter,	Lighter,

No. XIII.—*continued.*

of Conservators relative to Salmon Fisheries—*continued.*

In what months are the greatest quantities of Salmon (not Grilse) captured? 1902.	1903.	District.
June,	June,	Dublin.
April, May, and June,	April and May,	Wexford.
April, May, and June,	May and June,	Waterford.
February to early in May,	February to May,	Lismore.
February and March,	March and April,	Cork.
May and June,	May for nets; April for rods,	Cork (Bandon)
About 1st August,	August and September,	Skibbereen
June,	June,	Bantry.
June and July,	June and July,	Kenmare.
January to April,	February to April inclusive,	Waterville.
January to April,	January to April, inclusive,	Killarney.
April,	April and May,	Limerick.
April,	March to May inclusive,	Galway.
August and September on Screebe, Inver, and Costello. July and October in remainder of district.	August and September on Costello, Screeb, and Inver. Other fisheries July and October.	Connemara.
May and first week in June,	May and June,	Ballinakill.
April,	April and May,	Bangor.
February to May,	Up to May,	Ballina.
Sligo fishery March and April, and Ballisodare June and July.	January and February, in Sligo River May and June.	Sligo.
May,	May and June,	Ballyshannon
July and August,	July and August,	Letterkenny.
July and August,	July and August,	Londonderry.
In the sea May and August. In the rivers June.	May,	Coleraine.
Last half of May and first half of June,	April and from last week in July to end of season.	Ballycastle.
June to August,	February and March, April to June, inclusive.	Dundalk.
April,	—	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Can it be ascertained what proportion the capture of Grilse bears to the capture of Salmon? 1902.	1903.
Dublin,	10 to 1,	100 to 11,
Wexford,	2 to 1,	More than double the number of Salmon,
Waterford,	During ascent of Grilse from 4 to 6 to 1,	5 to 1 in tidal waters,
Lismore,	Cannot be ascertained,	No,
Cork,	About 2 to 1,	About 2 to 1,
Cork (Bandon),	About 2 to 1,	No,
Skibbereen,	About 4 to 1.	About equal
Bantry,	10 to 1,	15 to 1
Kenmare,	10 to 1,	10 to 1,
Waterville,	3 to 1,	About 2 to 1,
Killarney,	3 to 1,	About 3 to 1
Limerick,	About 12 to 1	6 to 1,
Galway,	Cannot be ascertained	5 to 1,
Connemara,	On Ballinahinch and Screebe about equal Other fisheries 3 to 1.	Ballinahinch and Screeb about equal; other fisheries 3 to 1.
Ballinakill,	30 to 1.	4 to 1,
Bangor,	20 to 1,	18 to 1,
Ballina,	Cannot be ascertained	Cannot tell,
Sligo,	Cannot be ascertained.	4 to 1.
Ballyshannon,	2 to 1,	2 to 1,
Letterkenny,	5 to 1,	5 to 1,
Londonderry,	Majority Grilse	No; but greater number of Grilse,
Coleraine,	From 2 to 3 to 1.	2 to 1,
Ballycastle,	Cannot be ascertained,	—
Dundalk,	Cannot be ascertained,	No,
Drogheda,	Cannot be ascertained	The capture of Salmon is far in excess of that of Grilse.

No. XIII.—*continued.*

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

Is there any increase in the average size of the Spring Salmon or Grilse? Give average weight of Salmon and Grilse in the season of this year as far as practicable. 1902.	1903.	DISTRICT.
Increase in case of Grilse. Salmon 14 lbs., Grilse 5 lbs.	No. Salmon 13lbs., Grilse 5 lbs., .	Dublin.
Salmon 11 or 12 lbs., Grilse 5 or 6 lbs., .	No. Salmon 12 lbs., Grilse 5 lbs.,	Wexford.
No. Salmon 12 to 14 lbs., Grilse 4 to 6 lbs.	No. Salmon 12 lbs. to 14 lbs., Grilse $4\frac{1}{2}$ lbs. to 5 lbs.	Waterford.
No. Salmon 17 lbs., Grilse 6 lbs.,	Yes. Salmon 14 lbs. to 27 lbs., Grilse 5 lbs. to 7 lbs.	Lismore.
No. Salmon 10 lbs., Grilse 4 lbs.,	No. Salmon 10 lbs., Grilse 3 lbs.,	Cork.
No. Salmon 12 lbs., Grilse $5\frac{1}{2}$ to 6 lbs.,	Yes.	Cork (Bandon).
No. 8 to 12 lbs.,	No. Salmon 9 lbs.,	Skibbereen.
No. Salmon 14 lbs., Grilse 5 lbs.,	Yes. Salmon 16 lbs., Grilse 6 lbs.,	Bantry.
Salmon 10 lbs., Grilse 6 lbs.,	No. Salmon 10 lbs., Grilse 6 lbs.,	Kenmare.
No increase in case of Spring Salmon. Increase in case of Grilse. Salmon 10lbs., Grilse 6 lbs.	No. Salmon 11 lbs., Grilse 6 lbs.,	Waterville.
Do., .	Salmon 11 lbs., Grilse 6 lbs.,	Killarney.
Yes. Salmon $19\frac{3}{4}$ lbs., Grilse 6 lbs.,	No. Salmon $16\frac{1}{4}$ lbs., Grilse $5\frac{1}{2}$ lbs.	Limerick.
Spring Salmon slightly lighter. Salmon about 14 lbs., Grilse $6\frac{1}{2}$ lbs.	No. Salmon $13\frac{1}{2}$ lbs., Grilse $6\frac{3}{4}$ lbs.,	Galway.
No. Salmon 10 lbs., Grilse 7 lbs.,	No. Salmon 10 lbs., Grilse 7 lbs.,	Connemara.
Spring Salmon 10 lbs., Grilse 7 lbs.,	Salmon 12 lbs., Grilse $6\frac{1}{4}$ lbs.,	Ballinakill.
Yes. Salmon $9\frac{1}{2}$ lbs., Grilse $6\frac{1}{2}$ lbs.,	No. Salmon 10 lbs., Grilse 6 lbs.,	Bangor.
No. 11 lbs. to $6\frac{1}{2}$ lbs., .	No. Salmon 10 lbs., Grilse 6 lbs.,	Ballina.
Yes. Salmon 7 to 20 lbs., Grilse $4\frac{1}{2}$ to 9 lbs.	Yes. Salmon 9 lbs., Grilse 6 lbs.,	Sligo.
Salmon lighter than last year $15\frac{3}{4}$ lbs., Grilse heavier, $7\frac{1}{2}$ lbs.	No. Salmon 15 lbs., Grilse $6\frac{1}{2}$ lbs.,	Ballyshannon.
Yes. Salmon 13 to 14 lbs., Grilse 6 to 8 lbs.	Yes. Salmon 14 lbs. to 15 lbs., Grilse 5 lbs. to 7 lbs.	Letterkenny.
No. Salmon 10 lbs., Grilse $6\frac{1}{2}$ lbs.,	No. Salmon 10 lbs., Grilse 6 lbs.,	Londonderry.
No. Salmon 12 lbs., Grilse 7 lbs.,	No. Salmon 11 lbs., Grilse 7 lbs.,	Coleraine.
No. 6 lbs.,	No. Salmon 10 lbs., to 20 lbs., Grilse 5 lbs. to 7 lbs.	Ballycastle.
No. Salmon 16 lbs., Grilse 7 lbs.,	No. Salmon 14 lbs., Grilse 6 lbs.,	Dundalk.
Salmon 13 lbs., Grilse 4 lbs.,	Cannot ascertain,	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

District.	Has any sign of disease been observed amongst the Salmon during the year? If so, describe it, and state if it has prevailed to any extent, and where?	
	1902.	1903.
Dublin,	No,	No,
Wexford,	No,	No,
Waterford,	No,	No,
Lismore,	No,	No.
Cork,	No,	No,
Cork (Bandon),	No,	No,
Skibbereen,	No,	No,
Bantry,	No,	No,
Kenmare,	No,	No,
Waterville,	No,	No,
Killarney,	No,	No,
Limerick,	No,	No.
Galway,	A few diseased Salmon (fungus) observed in drain at Galway.	Practically none,
Connemara,	No,	No
Ballinakill,	No,	No.
Bangor,	No,	No,
Ballina,	No,	No,
Sligo,	No,	No,
Ballyshannon,	No,	No,
Letterkenny,	No,	No,
Londonderry,	No,	No,
Coleraine,	No,	No,
Ballycastle,	One diseased Salmon taken in a net at sea,	No,
Dundalk,	No,	No,
Drogheda,	No,	No,

No. XIII.—*continued.*

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

Can you give any information about the run of Salmon and Grilse in each month of the close season?		DISTRICT.
1902.	1903.	
No, ...	Cannot be ascertained, ...	Dublin.
Salmon ascend to spawn from October to December. Grilse go up earlier.	Salmon run from October to December. Grilse earlier.	Wexford.
With suitable freshes the principal run of spawners is from latter end of October to end of November. Late spawners run in December, and even in January.	Depends on the condition of the water. Under favourable circumstances the great run of spawners occurs from middle of October to early in December.	Waterford.
A very large run of Peal and Salmon took place early in October. The fish appeared to be much smaller than usual.	In October and November a large run of Salmon and Peal took place. The number of spawning fish on the beds is much above the average.	Lismore.
No, ...	During October a fair number of fish passed to the upper waters.	Cork.
A number of fish ascended at end of October and early part of November. A large proportion were small (6 to 10 lbs.)	No, ...	Cork (Bandon).
Fish were observed running up four or five weeks after Close Season.	No, ...	Skibbereen.
No, ...	No, ...	Bantry.
No, ...	No, ...	Kenmare.
No, ...	Fairly good runs of Salmon take place in the months of January and December.	Waterville.
Run of Salmon small in August, September, and October. Grilse, however, were the more plentiful than for several years past.	In the months of August, September, and October the run of Salmon was rather slight, but there was the largest run of Grilse observed for the past ten years.	Killarney.
A very considerable run of Salmon took place in October, November, and December.	Largely dependent on the weather, .	Limerick.
No run until January, . . .	Practically no run during the Close Season until the Spring fish begin to run early in the year.	Galway.
No, ...	No, ...	Connemara.
No, ...	No, ...	Ballinakill.
No, ...	No information, ...	Bangor.
A good run of Grilse and small Salmon from end of August to December.	No, ...	Ballina.
No, ...	There was a good run during November and December.	Sligo.
No, ...	Cannot give information. . .	Ballyshannon.
No, ...	No, ...	Letterkenny.
Largest run in October, and November, .	Greatest runs are in October and November.	Londonderry.
Good run during September and October,	A good run of Salmon during October and November.	Coleraine.
No, ...	No reliable information, . . .	Ballycastle.
In October and November the run of Salmon and Grilse, especially the former, was larger than in former years.	A large run of Salmon in the month of October.	Dundalk.
No, ...	No, ...	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Have there been any cases of poisoning the rivers in the District? If so, give particulars of the different cases, and if by Lime, Spurge, or Flax Water.	
	1902.	1903.
Dublin,	No,	One case in River Liffey at Islandbridge,
Wexford,	No,	No,
Waterford,	No,	No,
Lismore,	No,	No,
Cork,	One case by chloride of lime. Offenders convicted.	One case of poisoning by spurge,
Cork (Bandon),	One case by flax water, little damage done,	One case of poisoning by flax water,
Skibbereen,	A hole was reported to be poisoned. It is believed that dynamite was used.	No,
Bantry,	Ballylickey or Owvane River was poisoned by spurge on one occasion.	One case of poisoning by spurge in the Ballylickey River.
Kenmare,	River Roughty poisoned six times; Sheen twice; and Finneby once by spurge.	Two cases of poisoning by spurge in tributaries of the Roughty River.
Waterville,	No,	No,
Killarney,	Brown Flesk poisoned four times by lime,	One case of poisoning by lime on the Brown Flesk.
Limerick,	Feale and Casben poisoned three times by lime.	No,
Galway,	No,	No,
Connemara,	No,	No,
Ballinakill,	No,	No,
Bangor,	No,	No,
Ballina,	No,	No,
Sligo,	No,	No,
Ballyshannon,	Very few cases. All by flax water,	None, except by flax water,
Letterkenny,	One case of poisoning by lime in Lennan River. Three men detected and fined.	A few cases of flax water poisoning.
Londonderry,	Great destruction caused by flax water,	One serious case of malicious poisoning by chloride of lime at Carrickmore. There were also many cases of flax water poisoning.
Coleraine,	Several cases of pollution by mills. Prosecutions instituted. Over 100 cases of flax water pollution.	Yes. Twenty-seven cases of flax water pollution, and four of pollution by effluent from factories.
Ballycastle,	Possibly two or three cases of pollution by flax water.	A few cases of flax water poisoning.
Dundalk,	A great many cases of flax water pollution. Lime has been observed in some of the small streams.	No,
Drogheda,	No,	—

No. XIII.—*continued.*

of Conservators relative to Salmon Fisheries—*continued.*

Has the quantity of Breeding Fish observed in the rivers in your District during this winter been greater or less as compared with last winter? 1902.	1903.	District.
Greater, ...	About the same, . . .	Dublin.
Greater, ...	Greater, ...	Wexford.
Much greater. On tributaries of Suir number is reported to be the greatest observed for nearly half a century.	Much greater. Greatest for past twenty years.	Waterford.
Greater, ...	Greater, ...	Lismore.
About the same, ...	About the same, ...	Cork.
Greater, ...	Greater, ...	Cork (Bandon)
No replies received, . . .	Much greater, ...	Skibbereen.
Greater, ...	Greater, ...	Bantry.
Greater, ...	Greater, ...	Kenmare.
Greater, ...	Much greater, ...	Waterville
Greater, ...	Greater, ...	Killarney.
Considerable increase. Best year in past twenty-five,	Greater, ...	Limerick.
Rather less, ...	Greater, ...	Galway.
No replies received, . . .	Greater, ...	Connemara.
Greater, ...	About the same, ...	Ballinakill.
Much greater, ...	Greater, ...	Bangor.
Greater, and observed earlier, . .	There was a good number of breeding fish but cannot make comparison with last year owing to high floods.	Ballina.
Much greater, ...	Much greater, ...	Sligo.
Greater, ...	Slightly greater, ...	Ballyshannon
Greater, ...	Greater, ...	Letterkenny.
Greater, ...	Greater, ...	Londonderry.
Greater, ...	Much less, ...	Coleraine.
Greater, ...	Greater, ...	Ballycastle.
Greater, ...	Greater, ...	Dundalk.
No replies received, . . .	Greater, ...	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	In what rivers has the quantity increased?	
	1902.	1903.
Dublin,	Liffey,	Liffey and Bray,
Wexford,	In all rivers,	In all rivers in the District,
Waterford,	In all rivers with the exception of a few of the lower tributaries.	In all tributaries, Freshford Brook (Nore), Fishoge, Burren, Live, Greese, and Douglas (Barrow).
Lismore,	In all tributaries and main river,	Blackwater and tributaries,
Cork,	None,	In Lee for the past few years,
Cork (Bandon),	In all rivers,	In all the rivers in District,
Skibbereen,	No replies received,	Ilen,
Bantry,	Ballylickey,	In all rivers in the District,
Kenmare,	All rivers, except Finnehy,	In all rivers in the District,
Waterville,	In all rivers,	In all rivers in the District,
Killarney,	Flesk, Goddock, and Caragh,	In all rivers in the District,
Limerick,	In all rivers, especially the Suck, Brosna, and Inny.	In all rivers in the District (with two or three exceptions) especially in the rivers about Nenagh.
Galway,	Increase in spawning Trout in Oughterard District.	In all rivers in the District,
Connemara,	No replies received,	In Gowla, Ballinahinch, Inver, Screeb, and Costello.
Ballinakill,	In all rivers,	In none,
Bangor,	In all rivers,	Owenmore and tributaries,
Ballina,	In all rivers owing to early floods, which occurred frequently.	Cannot say,
Sligo,	Drumcliff, Glencar, Bonnett, and tributaries,	In all rivers in the District,
Ballysbannon,	In all rivers,	Erne,
Letterkenny,	Owenea, Owentocker, Gweebarra, Clady, Gweedore, Lennan, and Swilly.	Lennan, Crana, Owenea, and Gweedore,
Londonderry,	In all,	In all rivers in the District,
Coleraine,	In majority of rivers, notably the Moyola and Blackwater.	—
Ballycastle,	Bush, Margy, Cary, and Glenhesk,	In all rivers in the District.
Dundalk,	Glyde and Dee,	In all rivers in the District,
Drogheda,	No replies received,	In all rivers in the District,

No. XIII.—*continued.*

of Conservators relative to Salmon Fisheries—*continued.*

In what rivers has the quantity decreased?		District.
1902.	1903.	
Bray,	Vartry,	Dublin.
—	—	Wexford.
In a few of the lowest tributaries,	Slight decrease in the Ratherann and Mouneen tributaries of Barrow.	Waterford.
—	—	Lismore.
None,	A decrease in Blarney River has been observed for past two years.	Cork.
—	—	Cork (Bandon).
No replies received,	—	Skibbereen.
No decrease,	—	Bantry.
Finnehy,	—	Kenmare.
—	—	Waterville.
—	—	Killarney.
—	Kellestry River near Killaloe, and Shannon at Castleconnell.	Limerick.
Rather less in all rivers, with exception of instance quoted in previous column.	—	Galway.
No replies received,	Doohulla and Skannive,	Connemara.
—	In none,	Ballinakill.
—	A slight decrease in those flowing into Carrowmore Lake.	Bangor.
—	Cannot say,	Ballina.
None,	—	Sligo.
—	No decrease reported,	Ballyshannon.
Crana and Lackagh,	No decrease reported,	Letterkenny.
—		Londonderry.
Kells,	In all rivers in the District,	Coleraine.
—	—	Ballycastle.
No decrease noticed,	—	Dundalk.
No replies received,	—	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Was the state of the rivers favourable or unfavourable to spawning, and to the protection of spawning, and spent fish, and young fry?	
	1902.	1903.
Dublin,	Liffey favourable. Bray fair,	Favourable in Liffey and Bray,
Wexford,	Favourable in all rivers,	Favourable,
Waterford,	Very favourable in all rivers owing to constant high water.	Most favourable,
Lismore,	Yes,	Favourable,
Cork,	Favourable,	Favourable,
Cork (Bandon),	Favourable.	Favourable in all rivers. Very favourable in Ilen.
Skibbereen,	No replies received,	Favourable,
Bantry,	State of Coombola and Ballylickey favourable, but for floods. State of Dunamark and Glengarriff favourable, but few fish spawned there.	Favourable,
Kenmare,	Favourable,	Favourable,
Waterville,	On the whole favourable,	—
Killarney,	Favourable,	—
Limerick,	Most favourable owing to floods,	Most favourable,
Galway,	Rivers rather low in early part of spawning season. Favourable afterwards. Favourable for descent of spent fish. Large numbers of fry are lost in swallow holes on Clare and Black Rivers.	Favourable,
Connemara,	No replies received,	Favourable,
Ballinakill,	Favourable,	Favourable,
Bangor,	Most favourable,	Favourable,
Ballina,	Favourable,	Unfavourable owing to high floods,
Sligo,	Favourable for spawning fish and fry; not quite so favourable for spent fish.	Very favourable,
Ballyshannon,	Favourable,	Most favourable.
Letterkenny,	Favourable owing to high water. Floods destroyed some spawning beds on the Swilly and Lennan River, but an ample number still remain.	Very favourable in Lennan, Crana, Owenea, and Gweedore.
Londonderry,	Fairly favourable for spawning,	Favourable,
Coleraine,	The state of most of the larger rivers was favourable. The state of the Kells and a few mountain streams was unfavourable owing to light water.	Favourable in all except the Kells River,
Ballycastle,	Nothing unfavourable in state of Bush, Margy, Glenhesk, and Cary. Glenarm fairly favourable.	Very favourable in Bush. Favourable in Glenhesk, Margy, and Glenarm.
Dundalk,	Favourable owing to continued floods. The run of fish on the Fane was later than in other rivers.	Favourable,
Drogheda,	No replies received,	Favourable,

No. XIII.—*continued.*

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

Any particular observations? 1902	1903	DISTRICT.
—	—	Dublin.
—	—	Wexford.
—	—	Waterford.
The spawning Salmon were very small.	—	Lismore.
—	During the months of March and April, 1903, a very large number of fry passed to the sea.	Cork.
—	—	Cork (Bandon).
—	The great increase in the number of spawning fish is due to the fry put into the river by the Board of Conservators.	Skibbereen.
—	Greater number of spawning fish observed than for the past ten or twelve years.	Bantry.
—	—	Kenmare.
—	—	Waterville.
—	—	Killarney.
—	—	Limerick.
Breeding grounds on upper waters are not secure against drought.	A number of men were employed to pick up and clean the gravel in the inland rivers which had become hard and overgrown with weeds. This proved a great success, every place so treated was during the season fully utilized by breeding fish.	Galway.
—	—	Connemara.
—	—	Ballinakill.
—	—	Bangor.
Fisheries of District appear to be recovering,	—	Ballina.
—	Board's funds insufficient to improve spawning beds.	Sligo.
—	—	Ballyshannon.
—	—	Letterkenny.
—	—	Londonderry.
Spawning Salmon are larger than usual, and more plentiful than for last fifteen years.	Spawning salmon were much larger and spawned earlier in the year.	Coleraine.
An unprecedented flood in middle of January washed away beds of rivers in many places, and it is feared caused an enormous amount of damage.	—	Ballycastle.
—	—	Dundalk.
—	—	Drogheda.

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List of Publications relating to Scientific Investigations.

Report on the Sea and Inland Fisheries of Ireland for 1901, Part II., Scientific Investigations. (1903. Cd. 1577.) Price 4s. 5d.

Report on the Sea and Inland Fisheries of Ireland, 1902-1903, Part II., Scientific Investigations. (1905. Cd. 2535.) Price 8s. 7d.

The above can be obtained, either directly or through any bookseller, from the Government Sale Agents:—E. Ponsonby, 116, Grafton-street, Dublin; or Wyman & Sons, Ltd., Fetter-lane, London, E.C., and 32, Abingdon-street, Westminster, S.W.; or Oliver & Boyd, Edinburgh.

The following papers have been published separately, and can be obtained on application to the Scientific Adviser, Fisheries Branch, Department of Agriculture, &c., Dublin.

Holt, E. W. L.—The Public Oyster Beds on the Coasts of Counties Wicklow and Wexford, pp. 33.
Ann. Rep. Fish., Ireland, 1901, *Pt. II., App., II.* [1903.]

Holt, E. W. L., and Byrne, L. W.—The British and Irish Gobies, pp. 30, pl. 2.
Ann. Rep. Fish., Ireland, 1901, *Pt. II., App., III.* [1903.]

Holt, E. W. L., and Byrne, L. W.—On a Young Stage of the White Sole, *Pleuronectes (Glyptocephalus) cynoglossus*, pp. 3, pl. 1.
Ann. Rep. Fish., Ireland, 1901, *Pt. II., App., IV.* [1903.]

Holt, E. W. L., and Byrne, L. W.—The British and Irish Species of the Family Stromateidae, pp. 7, pl. 2.
Ann. Rep. Fish., Ireland, 1901, *Pt. II., App., V.* [1903.]

Wollebaek, Alf.—A Norwegian Method of Oyster Culture (Translation), pp. 27, pl. 10.
Ann. Rep. Fish., Ireland, 1901, *Pt. II., App., VI.* [1903.]

Farran, G. P.—Record of the Copepoda taken on the Mackerel Fishing Grounds off Cleggan, Co. Galway, in 1901, pp 18, pl. 2.
Ann. Rep. Fish., Ireland, 1901, *Pt. II., App., VII.* [1903.]

Farran, G. P.—The Nudibranchiate Molluscs of Ballynakill and Bofin Harbours, Co. Galway, pp. 10, pl. 2.
Ann. Rep. Fish., Ireland, 1901, *Pt. II., App., VIII.* [1903.]

Cole, Grenville A. J., and Crook, T.—On Rock Specimens dredged from the Floor of the Atlantic off the West Coast of Ireland in 1901, pp. 9, pl. 3.
Ann. Rep. Fish., Ireland, 1901, *Pt. II., App., IX.* [1903.]

Green, C.—Drawings and Descriptions of Apparatus used in Salmon and Trout Culture, pp. 8, pl. 6.
Ann. Rep. Fish., Ireland, 1901, *Pt. II., App., XIV.* [1903.]

The following will be ready shortly :—

DELAP, M. and C.—(i.) Notes on the Plankton of Valencia Harbour, 1899-1901; (ii.) Notes on the rearing, in an Aquarium, of *Cyanea Lamarcki*, Peron and Lesueur, pp. 20, pl. 2.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App. I.* [1905.]

FARRAN, G. P.—Report on the Copepoda of the Atlantic Slope off Counties Mayo and Galway, pp. 30, pl. 11.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., II.* [1905.]

SYKES, E. R.—The Molluscs and Brachiopods of Ballynakill and Bofin Harbours, Co. Galway, and of the deep water off the West and South-West Coasts of Ireland, pp. 40; and

HOYLE, W. E.—On Specimens of *Tracheloteuthis* and *Cirroteuthis* from deep water off the West Coast of Ireland, pp. 6, pl. 1, maps 2.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., III.* [1905.]

HOLT, E. W. L., and TATTERSALL, W. M.—Schizopodous Crustacea from the North-East Atlantic Slope, pp. 54, pl. 11; and

CALMAN, W. T.—Note on a Genus of Euphausid Crustacea, pp. 3, pl. 1.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., IV.* [1905.]

HOLT, E. W. L., and BYRNE, L. W.—(i.) Note on a Specimen of *Dentex vulgaris* from Dingle Bay, pp. 6, pl. 1; (ii.) The British and Irish Gobies, Supplement, pp. 2, pl. 1; (iii.) Figures and Descriptions of the British and Irish Species of *Solea*, pp. 12, pl. 6.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., V.* [1905.]

KEMP, S. W.—Echinoderms of Ballynakill and Bofin Harbours, Co. Galway, and of the Deep Water off the West Coast of Ireland, pp. 31, pl. 1.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., VI.* [1905.]

FARRAN, G. P.—(i) Additions to the List of Nudibranchiate Molluscs of Ballynakill Harbour, Co. Galway; (ii.) Rediscovery of the Nudibranch *Alderia modesta* (Lovén); (iii.) Occurrence of the Floating Barnacle, *Lepas fascicularis* (Ellis and Sol.), and

TATTERSALL, W. M.—(iv.) On *Nebalia typhlops*, G. O. Sars; (v.) On Stomatopod larvae from the West Coast of Ireland; (v.) Enteropneusta from the West Coast of Ireland, pp. 8.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., VII.* [1905.]

HOLT, E. W. L, and HILLAS, A. B. E.—Preliminary Report on Experiments in Oyster Culture on the West Coast of Ireland, pp. 118.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., VIII.* [1905.]

Quarterly Observations of Temperature, s.s. "Helga," pp. 11.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., IX.* [1905.]

HOLT, E. W. L.—Note on the Manurial Value of the Seaweed *Cladophora rupestris*, pp. 2.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., X.* [1905.]

HOLT, E. W. L.—Report on the Artificial Propagation of Salmonidae for the Seasons of 1902-1903, and 1903-1904, pp. 5, and

GREEN, C.—Preliminary Note on the Size of Salmon Eggs, in relation to Estimating their Number, pp. 2, and

OLIVER, CHARLES DEANE.—Report on the Salmon Hatchery at Lismore, pp. 6, pl. 3, together with

Statistical Information relating to the Salmon Fisheries, pp. 4, and
Substance of Reports received from Clerks of Conservators relative to Salmon Fisheries, pp. 23.
Ann. Rep. Fish., Ireland, 1902-3, *Pt. II., App., XI, XII, XIII.* [1905.]